DISTRIBUTION, STATUS AND CONSERVATION OF INDIAN HERONRIES

S. SUBRAMANYA[1]

(With four-text figures)

The current state of knowledge on the colonial waterbird nesting sites (heronries) in India is presented. The information gathered on over 533 nesting sites of 26 species of Pelecanidae, Phalacrocoracidae, Ardeidae, Ciconiidae and Threskiornithidae indicate a distinct concentration of 360 existing sites in southern India, western and north central India and Assam in the Northeast. Of the species considered, Little Cormorant, Night Heron, Pond Heron, Cattle Egret and Little Egret were the most common nesting species in the heronries. Available information showed the existence of variation in the number and type of species nesting in different states of India. Analysis of the habitats in which the nest sites occur indicated that nearly 53% of the existing sites were found within or close to human habitation. While only a few sites have been in existence from well over a century, a number of sites were found to have come into existence in the last five decades. Over the last century, about 173 sites have been lost for several reasons. Only a small proportion of the existing heronries were found in protected areas. Several large heronries in India have been identified and the study has enabled us to understand how heronries come into existence. The existing sites are prone to a number of threats and disturbances and the influence of natural calamities. The current status and future options for conservation of heronries in India are discussed.

INTRODUCTION

The habit of nesting colonially is an important feature among a majority of the members of Pelecaniformes and Ciconiiformes (Ali and Ripley 1987, Burger 1981, Krebs 1978). A majority of species representing these two groups in India are known to nest colonially (Ali and Ripley 1987). The nesting colonies of these birds that represent spatial and temporal clumping of nests are popularly referred to as heronries. The information available on such heronries in India pertains mainly to a few regional studies (e.g. Mahabal 1990, Nagulu and Rao 1983, Naik *et al.* 1991, Naik and Parasharya 1987, Parasharya and Naik 1990, Santharam and Menon 1991, Sharatchandra 1980, Singh and Sodhi 1986), several site specific studies (e.g. Chaudhari and Chakrabarti 1973, Datta and Pal 1990, 1993; Gee 1960, Nagulu 1983, Neelakantan 1949, Neginhal 1983, Paulraj 1984, Ragunatha 1993, Ragunatha *et al.* 1992, Sanjay 1993, Subramanya *et al.* 1991, Subramanya and Manu 1996, Urfi 1989c, 1990, 1992, 1993a, 1993b; Vijayan 1991) and a number of site records (e.g. Abdulali 1962, Ali 1960, Baker 1935, Barnes 1886, 1891; Barooah 1991, Bates and Lowther 1952, Badshah 1963, Betham 1904, Bingham 1876, Bhat *et al.* 1991, Bolster 1923, Chhaya 1980, Daniel 1980, Ganguli 1975, Hume 1881, Jamgaonkar *et al.* 1994, Naik 1987, Neelakantan and Elamon 1984, Packard 1903, Subramanya 1993, Urfi 1992, Uttaman 1990, Webb-Peploe 1945, Wilkinson 1961). Despite the availability of such an information base on heronries in India, no concerted effort has been made so far to determine their distribution, status and conservation needs. Even an earlier attempt by Betts (1937) in this direction was not fruitful. This paper is an effort towards bridging this gap in Indian ornithology and presents an overview of the information gathered as part of a much larger project (Subramanya, unpublished).

METHODS

Between 1993-95, questionnaires requesting information on heronries were sent to over 700 birdwatchers, ornithologists and naturalists in

[1]PHT Scheme 'J' Block, G.K.V.K. Campus, University of Agricultural Sciences, Bangalore 560 065, India.

different parts of India (Subramanya 1993). Details on location, breeding season, status, nesting site, colony size, species breeding at the site and the available published information on heronries were collected from contributors. Habitually solitary nesting species (Black Ibis, *Pseudibis papillosa* and Whitenecked (Woolly-necked) Stork, *Ciconia episcopus*) found nesting in heronries were also included in the study. Thus, 26 species (Table 1) were considered in the survey. Details on some active sites and those that once existed within Indian limits were obtained through published literature.

The available data on the number of heronries in which each of the 26 nesting species were nesting and the abundance of heronries in different Indian states were subjected to cluster analysis (Ludwig and Renolds 1988), to group species with similar dispersal patterns.

The nomenclature follows Ali and Ripley (1987) and Sonobe and Usui (1993). All the abbreviations of species mentioned in the tables are as per Table 1. The details of some of the heronries are presented in Appendix I.

TABLE 1
DETAILS OF SPECIES CONSIDERED IN THE HERONRY SURVEY

Species details	Code
PELICANIFORMES	
PELECANIDAE	
Great White (Rosy) Pelican *Pelecanus onocrotalus*	GWP
Spotbilled Pelican *P. philippensis*	SBP
PHALACROCORACIDAE	
Great Cormorant *Phaldcrocorax carbo*	GC
Indian Shag *P. fuscicollis*	IS
Little Cormorant *P. niger*	LC
Oriental Darter *Anhinga melanogaster*	OD
CICONIIFORMES	
ARDEIDAE	
Night Heron *Nycticorax nycticorax*	NH
Pond Heron *Ardeola grayii*	PH
Chinese Pond Heron *A. bacchus*	CPH
Cattle Egret *Bubulcus ibis*	CE
Western Reef Egret *Egretta gularis*	WRE
Eastern Reef Egret *Egretta sacra*	ERE
Little Egret *E. garzetta*	LE
Smaller Egret *E. intermedia*	SE
Great Egret *E. alba*	GE
Purple Heron *Ardea purpurea*	PrH
Grey Heron *A. cinerea*	GH
CICONIIDAE	
Painted Stork *Mycteria leucocephala*	PS
Asian Openbill *Anastomus oscitans*	OBS
Woolly-necked (White-necked) Stork *Ciconia episcopus*	WNS
Lesser Adjutant Stork *Leptoptilos javanicus*	LA
Greater Adjutant Stork *L. dubius*	GA
THRESKIORNITHIDAE	
White (Black-headed) Ibis *Threskiornis melanocephalus*	BHI
Black Ibis *Pseudibis papillosa*	BI
Glossy Ibis *Plegadis falcinellus*	GI
White Spoonbill *Platalea leucorodia*	WSB

RESULTS AND DISCUSSION

Abundance of Nesting Species: The questionnaire survey and review of literature yielded information on 360 active sites. The number of sites in which each of the 26 species nesting in heronries have been recorded, is presented in Fig 1. Of the 26 species considered, Little Cormorant, Night Heron, Pond Heron, Cattle Egret and Little Egret were the most abundant nesting species in Indian heronries and were found nesting in over 100 sites. The most common nesting species in Indian heronries was the Little Egret which nests in about 150 sites. The Spotbilled Pelican, Lesser Adjutant, Greater Adjutant and the Glossy Ibis were found to nest in less than 20 heronries (Fig. 1).

Among the 26 species considered, the Little Cormorant, Night Heron, Pond Heron, Cattle Egret and the Little Egret were the most abundant nesting species in Indian heronries (Fig. 1). Glossy Ibis which was known to breed in Lucknow (Oude), Orissa, and Assam (Baker 1935), was found nesting only at the Luna village, Banni grassland in the Kutch region (Tiwari 1993 and pers. comm.) and at the Panidihing Heronry in Assam (D. Barooah, P. Kumar Saikia & Anwaruddin Choudhury, pers. comm.). Baker (1935) recorded colonies of Chinese Egrets at North and South Lakhimpur, Tinsukia Railway Station and Dhimaji town. The present survey has

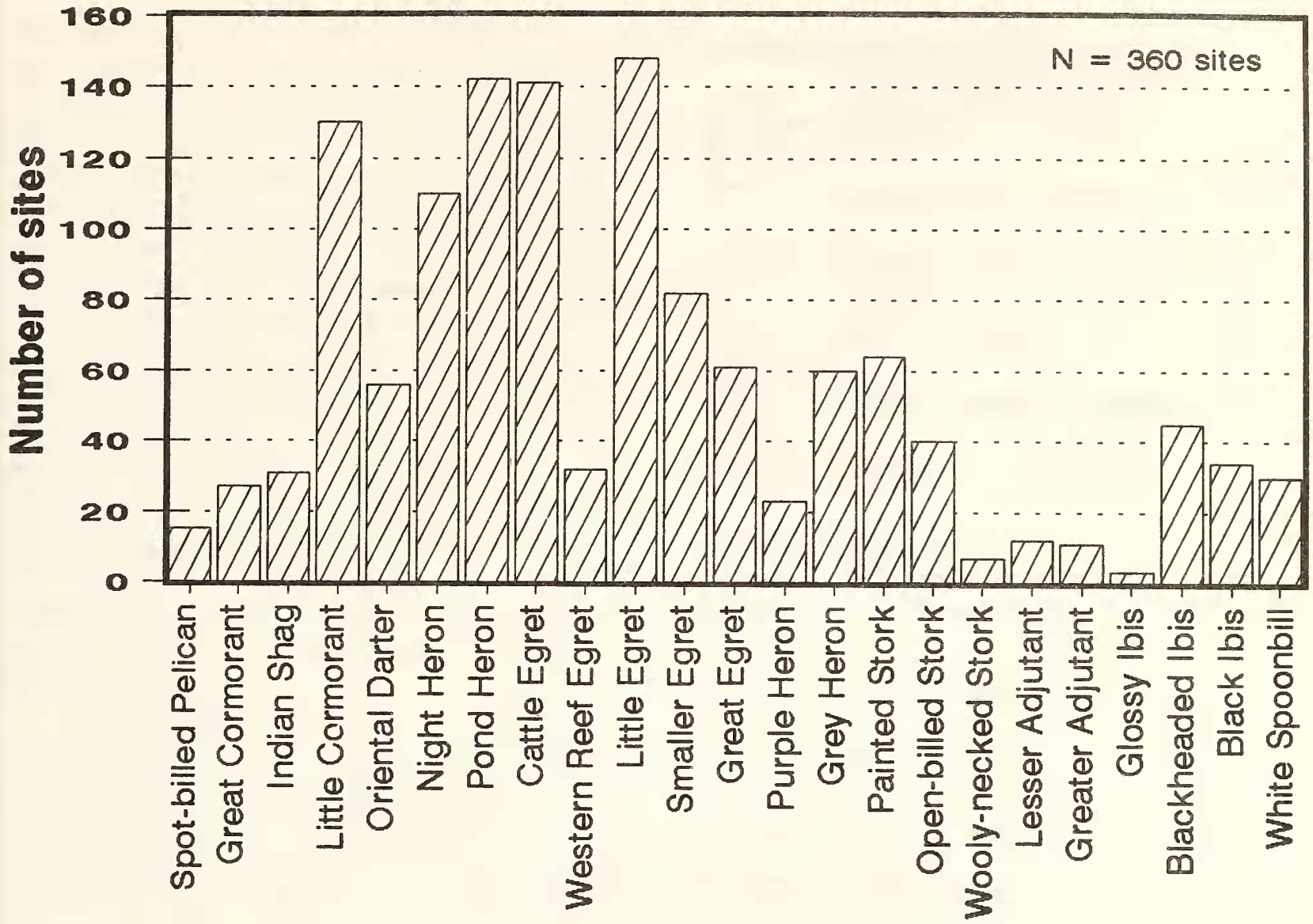

Fig. 1. Number of sites recorded for different bird species nesting in heronries.

only revealed suspected nesting of the species at the Panidihing Heronry (Diptimanta Barooah, pers. comm.). But for nesting prior to 1930s (Hume and Oates 1890, Baker 1935), no recent information on the nesting colonies of the Eastern Reef Egret is available. Similarly, information could not be obtained on the present status of the nesting colony of Great White Pelican visited by Ali (1960) and Shivrajkumar *et al.* (1961).

An analysis of the frequency and distribution of bird species currently nesting in heronries across different states revealed four distinct groups (Fig. 2). While the Little Cormorant, Pond and Night Herons, Cattle, Little, Smaller and Great Egrets were the most widespread nesting species in India, the group with highly restricted distribution of species included Spotbilled Pelican, Greater and Lesser Adjutant Storks, Whitenecked (Woolly-necked) Stork, Glossy Ibis and the Western Reef Egret. The group with partly restricted distribution included the Great Cormorant, Purple Heron, Indian Shag, Oriental Darter and the Black Ibis. The rest of the species were part of the less widespread group (Fig. 2).

Distribution of Heronries: Mapping of the heronries in India indicated a distinct concentration of sites in southern India, western and north central India and Assam in the North-east (Fig. 3). Also, the distribution of heronries within India indicated a clear concentration along the coasts and coastal plains, arid and semi-arid regions, Brahmaputra floodplain (with the exception of Ganges floodplain) and Western Ghats. Central India, south of the Himalayas, eastern India including interior Orissa and West Bengal appears to be impoverished of these nesting sites. The notable absence of heronries in

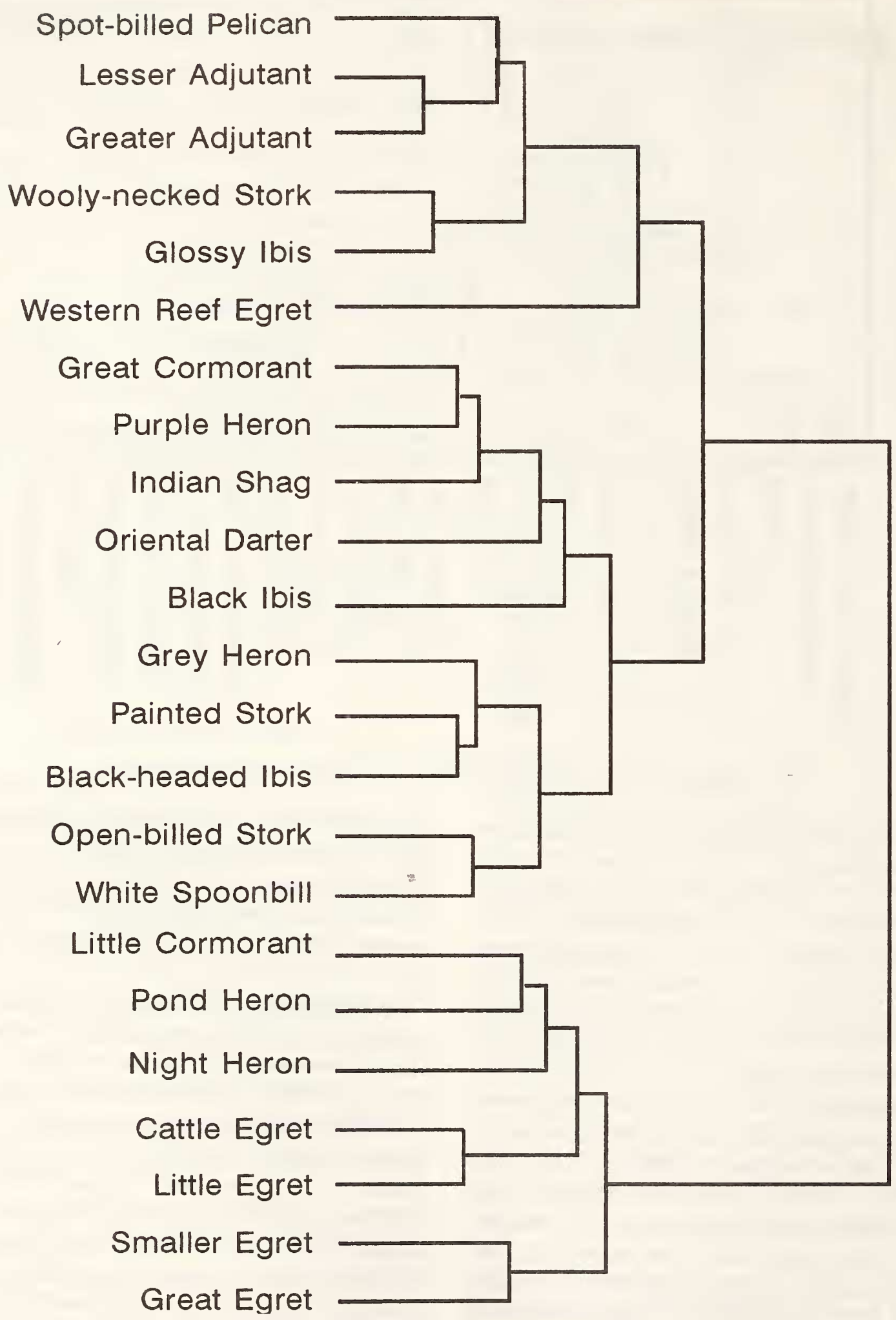

Fig. 2. Grouping of different bird species based on their nesting distributions in different parts of India.

these regions, especially in the Gangetic plain, is quite surprising. It is also possible that efforts have not been made to look for heronries in this region despite their existence. Only a concerted search for nesting sites will reveal the true status. In fact, intensive searches have revealed the occurrence of a large number of heronries in a given region. The 14 heronries seen at the Raigad district, Maharashtra (Mahabal 1990), and the 44 nesting sites of Cattle and Little Egrets found in the Kharar tehsil of Ropar district in Punjab (Singh and Sodhi 1985) indicate that often, in intensely cultivated areas, the density of heronries can be appreciably high. On the other hand, these areas may be truly impoverished. In Bihar, for example, it is very difficult to find nesting sites of colonial waterbirds or for an active site to exist for long, as most of them are destroyed by local people out to secure easy meat and eggs (S.A. Hussain, pers. comm.).

The occurrence of heronries in a particular region is dependent on the availability of suitable feeding conditions for waterbirds (Bancroft *et al.* 1988, Carrascal *et al.* 1993, Gibbs *et al.* 1987). Thus, a comparison of the distribution of wetlands censused during the Asian Midwinter Waterfowl Census (Perennou *et al.* 1994) and the distribution of heronries indicate that the occurrence of heronries closely follows the distribution of wetlands where they feed. When one considers the types of wetlands that occur in different parts of India (Perennou and Mundkur 1991, 1992; Perennou, Rose and Poole 1990, Scott and Rose 1989, van der Ven 1987, Hussain and Roy 1993), it appears that in central and eastern Gujarat, eastern Rajasthan and in the whole of Deccan Plateau, excluding the coastal regions, the heronries are mainly dependent on man-made waterbodies like tanks and large reservoirs. In the Deccan Plateau, a large number of man-made inland irrigation tanks play an important role in providing ideal feeding conditions to waterbirds (Subramanya 1990, Sampat 1993) and also in supporting a number of heronries (Table 2).

There is a dense concentration of heronries along the east and west coasts of India. Coastal wetlands like lagoons, backwaters, estuaries, mangroves, mud flats, etc. occurring within about 35 km from the coasts seem to have a strong influence on the distribution of nesting sites along the coasts. Similarly, in the Southern Gulf of Kutch coastal wetlands (Naik *et al.* 1991) and in Assam, the Brahmaputra floodplain, with its associated beels, provides important feeding areas for the colonial nesting waterbirds (Baker 1935).

TABLE 2
SITES PREFERRED BY COLONIAL NESTING WATERBIRDS IN INDIA*

Type of nesting sites	Per cent Frequency
Trees in villages	23.87
Trees in towns/cities	23.37
Trees in fresh waterbodies	11.06
Trees close to fresh waterbodies	11.32
Wooded areas	8.04
Trees near habitations	5.28
Trees in Coastal area	3.77
Reedbeds	3.52
Trees on Coastal islands	3.52
Trees on islands	3.27
Tree stumps in reservoirs	1.51
Trees among cultivations	1.26
Trees in aviaries	0.26

*N = 354 sites

Nesting Habitats: The nesting sites of the 26 species of colonially nesting waterbirds have been recorded to occur in as many as 13 different habitat types. The frequency distribution of such nesting sites is presented in Table 2. Nearly 53 % of the observed nesting sites were found either within or close to human habitations. Only about 31 per cent of the sites were found to occur within or close to fresh water bodies. Around 7% of the sites were found in coastal areas and coastal islands: Reed-beds were one of the preferred nesting substrate once, as at Brahmaputra Valley (Baker 1935, Hume and Oates 1890) and Kashmir (Bates 1929). Only a few such reed-bed nesting sites have been reported. In about eight per cent of the sites, heronries were located within or close to wooded areas, as at Raiganj in the West Dinapur district of West Bengal (Datta and Pal 1990, 1993; Shahi 1983).

Several nesting colonies of the Great

TABLE 3
DETAILS OF HERONRIES FOUND INSIDE LARGE RESERVOIRS

Name of the Reservoir	State	District	Nesting Species	Source*
Kabini Backwaters	Karnataka	Mysore	GC, OD	Ullas Karanth
Mandagadde		Shimoga	LIC, IS, OD, NH, PH, LE, SE, GE, PrH, BHI, WSB	S.G. Neginhal; Subramanya, 1993
Attiveri		Uttara Kannada	IS, LC, OD, CE, PS, NHI, WSB	P.D. Sudershan; R. N. Desai
Periyar Wildlife Sanctuary	Kerala	Idukki	GC, OD, WNS	Jafer Palot; Thomas Nelson
Chimmoni		Trichur	GC, IS, LC, OD, PH, PS, WNS, WSB	E.A. Jayson, P.S. Easa & P.V. Prabhakaran; J. Praveen
Parambikulam		Palakkad	GC, LC, NH, GH	Sabel Martinaz & Andy Eliott
Upper Glenmorgan Headworks	Tamil Nadu	Udagamandalam	GC	Manoj V. Nair; Nair 1996
Kota Dam	Rajasthan	Kota	NH	R.G. Soni

* Names refer to information obtained through personal communications

Cormorant and Darter are found on dead tree trunks partially submerged in water in the backwaters of large reservoirs (Table 3). The partially submerged tree trunks became available to the birds, subsequent to the submergence of forest in river valleys. The most unusual record was at the Kota Dam in Rajasthan, where Night Herons which usually prefer the seclusion of a dense tree canopy for breeding (Baker 1935, Ali and Ripley 1987), were nesting openly on exposed tree trunks (Soni 1992).

Site Tenacity: Affinity to nest at a site or close to a site where they previously nested appears to be very strong among colonial waterbirds. At sites where they have enjoyed long years of protection, birds exhibit intense site tenacity. However, their continued nesting at the site even after a disaster appears to depend on the extent of damage to the nesting substrate and the availability of alternate nesting substrate at the site. When flash floods ravaged Ranganathittu Bird Sanctuary during 1991, over 1500 nests were swept away by the surging waters, but the birds started re-nesting once the floods abated (Subramanya *et al.* 1991). When the preferred nesting tree was cut down by villagers at Mathikere Heronry in Karnataka, the birds nested on nearby trees which had not been used. Similarly, when the Neem tree on which Openbill Storks were nesting at Tsunduru Village in Andhra Pradesh was affected by a cyclone in 1990, the birds successfully shifted over to nest on *Polyalthia longifolia* (K. Mruthunjaya Rao, pers. comm.).

Since the availability of a suitable feeding site is an important consideration for the choice of a specific site, the intense site tenacity showed by nesting species is an indication that their feeding habitats in the surrounding area are intact. Birds do not appear to shift to a new locality or abandon the site unless alternate nesting substrate is available. In such situations, total destruction or uprooting of all the available nesting substrates at the site forces the nesting population to shift to an alternate site close by as seen at Jagrugumilli Village Heronry in Prakasham district, Andhra Pradesh. After a devastating cyclone in 1979, the birds nesting at

Fig. 3. Distribution of heronries in India.

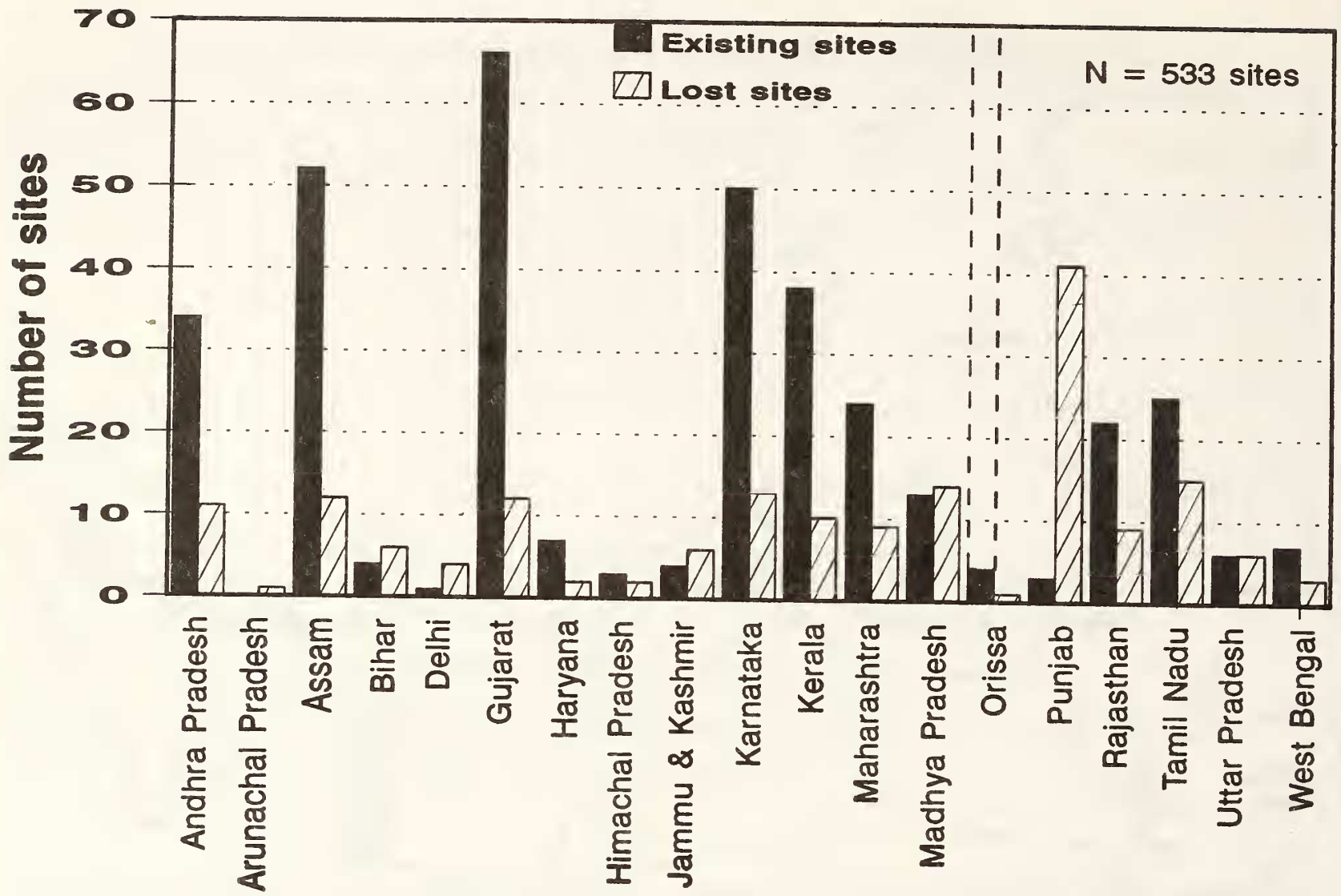

Fig. 4. Number of existing and lost heronries in different states of India. Hatched histogram indicates the number of sites known to exist in Orissa.

Jagrugumilli Village Heronry shifted to Patchava Village about 8 km away, when alternate nesting substrates were not available. Similarly, a thunderstorm destroyed the crown of an *Acacia nilotica* tree in Cuddapah city during 1989 and the Pond Heron, Cattle Egret and Little Egrets which were nesting on the tree regularly, abandoned the site (Riazuddin, pers. comm.).

Existing Sites: Details of the number of heronries recorded in 18 Indian states and one union territory is presented in Fig. 4. Though the figure pertains to the information that was sent by contributors, there could still be a large number of heronries which have not yet been located by birdwatchers or heronries on which information was not shared. For example, with the assured feeding opportunity available at Chilka Lake in Orissa, every village located around the lake is known to have a small to medium sized heronry (Sudhakar Kar, pers. comm.). Similarly, within Mysore District, Karnataka, every tank supporting a dense patch of bulrush reeds (*Typha* sp.) is known to invariably contain one or two nests of Purple Heron (K. Manu, pers. comm.). However, with the available information, it was found that Gujarat supports the largest number of heronries in India (68 known sites) followed closely by Assam and Karnataka (around 50 sites) and Kerala with 38 sites. Less than ten heronries were recorded in Arunachal Pradesh, Bihar, Delhi, Haryana, Himachal Pradesh, Jammu and Kashmir, Orissa, Punjab, Uttar Pradesh and West Bengal (Fig. 3).

All the Adjutant Stork colonies are located in Assam (Changkakati and Das 1991, Choudhury 1993, Raj 1990, Saikia and Bhattacharjee 1990a, b). Though the Lesser Adjutant was once known to nest

in Kerala (Travancore) and parts of Malabar coast in the south-west, east coast, Orissa and Assam (Baker 1935), the nesting of Lesser Adjutant at the Bhitarkanika Wildlife Sanctuary is the only recent record of the species nesting outside north-eastern India (Pandey 1993). The recent reported nesting of the Black Stork *Ciconia nigra* (Datta 1996) is the first ever record of the species nesting within Indian limits.

The bulk of the nesting colonies of Western Reef Egrets are found in Gujarat where they nest in coastal area, coastal cities and coastal islands (Ali 1945, 1954; Naik 1991, Naik *et al.* 1991, Naik and Parasharya 1987, Parasharya and Naik 1990, Ranjitsinh 1985, Taej Mundkur and Lavkumar Khacher, pers. comm.). Hitherto, the colony near Nellore (Kirkpatrick 1961) was the only known nesting site of the species on the east coast. This site is no longer active. The present survey has brought to light two unknown nesting sites of the species on the east coast in Andhra Pradesh located at the Coringa Wildlife Sanctuary (Ashok Kumar; V. Vasudeva Rao and V. Nagulu, pers. comm.) and the Lankivanidibba of Repalle range of Krishna estuary (Narendra Prasad, pers. comm., Prasad 1992). It is quite possible that more of these sites may exist on the east coast and on the west coast, south of Gujarat. Only a determined effort to locate additional nesting sites may reveal their existence.

The present survey has revealed that the Spotbilled Pelican breeds in about 15 sites distributed over Andhra Pradesh, Assam, Karnataka and Tamil Nadu (Subramanya, unpublished). Considering this, the report of the presence of only four colonies of the species in India in 1982 (Crivelli and Schreiber 1984) is incorrect as at least ten of the present nesting sites have been active for well over two decades (Subramanya, unpublished).

Of the existing heronries, some of the colonies are known to be active since several decades or even centuries (Table 4). However, very few such sites exist today and the main reason for their survival is the quality of protection they have enjoyed in the locality, either by State Forest Departments or through the sentiments of the local people. The list of some of these active sites shown in Table 4 is by no means complete and needs updating.

Reference to heronries prior to re-organisation of Indian states abounds in Indian ornithological literature. However, it is difficult to confirm their present day locations. For example, the large heronry with thousands of nesting birds located half-way between a place known as Tangalle and Mathura (Matura) referred to by Hume and Oates (1890), could well be the present day Keoladeo National Park. There appears to be little doubt that the pelicanry visited by Jerdon (1864) in Karnataka (Carnatic) is the present day Kokkare Bellur Pelicanry, where Spotbilled Pelicans nest in association with Painted Storks on trees in the middle of a village (Nagulu and Rao 1983, Neginhal 1976, 1993; Sanjay 1993).

Searching for some of the old heronries could be a tedious task. Nevertheless, given time and effort, the present day status of these sites can be known. Baker (1935) had visited an extremely large Great Cormorant colony of over 3000 pairs located on the rocky banks of Subansiri River several kilometres before it debouches into the plains. Recent searches have revealed that the colony exists even today, but only a small number of birds nest at the site (Anwaruddin Choudhury, pers. comm.).

Large heronries in India: The number of birds nesting in heronries varies greatly and only a few sites qualify to be considered as large heronries. Table 5 lists the top ten heronries in India where over 5,000 pairs or nests have been recorded. However, this list is far from complete and needs updating.

Traditional nesting sites: Heronries where birds return each year to breed regularly become traditional nesting sites. As the availability of suitable feeding conditions in the surrounding area and safe nesting sites in the locality are the two factors governing the occurrence of heronries (Bancroft *et al.* 1988, Carrascal *et al.* 1993, Gibbs *et al.* 1987, Parasharya and Naik 1990), continued survival of these nesting sites is an indirect indication that the feeding areas of nesting birds are in a healthy state. As a consequence, birds return to such sites year after year. Table 6 lists some of the traditional nesting sites

TABLE 4
SOME OF THE OLDEST INDIAN HERONRIES STILL ACTIVE IN INDIA

Name of the heronry	State	District	Nesting species	Year of earliest record	Source*
Subansiri Colony	Arunachal Pradesh	Upper Subansiri	GC	1930s	Baker, 1935
Neelapattu	Andhra Pradesh	Nellore	SBP, LC, LE, GH, OBS, BHI, WSP	1983	Nagulu, 1983, Nagulu and Rao, 1983
Telineelapuram	Andhra Pradesh	Srikakulam	SBP, PS	1983	Nagulu and Rao, 1983
Ethirapattu	Andhra Pradesh	Nellore	LC, LE, PS, WSB	1983	Ramakrishna, 1986, V. Nagulu & Joel Prashanth
Kaziranga Pelicanry	Assam	Golaghat	SBP	1950s?	Anwaruddin Choudhuri
Kokkare Bellur Pelicanry	Karnataka	Mandya	SBP, PH, PS, BHI	1860s	Neginhal, 1976, 1993; Sanjay, 1993
Ranganathittu Bird Sanctuary	Karnataka	Mysore	GC, IS, LC, OD, NH, PH, CE, LE, SE, GE, PrH, GH, PS, OBS, BHI, WSB	1930?	Ali, 1943, Neghinhal, 1983
Gudvi Bird Sanctuary	Karnataka	Shimoga	IS, LC, OD, NH, PH, LE, SE, GE, PrH, BHI, WSB	1800s?	Ragunatha, 1993, Ragunatha *et al.*, 1992
Periyar Wildlife Sanctuary	Kerala	Idukki	GC, OD, WNS	1900?	Jafer Palot
Kumarakam	Kerala	Kottayam	GC, IS, LC, OD, NH, PH, LE, SE, GE, PrH	1980s	Sreekumar; Neelakantan & Elamon, 1984
Bhitarakannika Wildlife Sanctuary	Orissa	Cuttack	LC, OD, NH, SE, PrH, GH, OBS, LA	1900?	Sudhakar Kar; Vivash Pandey
Keoladeo National Park	Rajasthan	Bharatpur	GC, IS, LC, OD, NH, PH, CE, LE, SE, GE, PrH, GH, PS, OBS, BHI, WSB	1919	Baker, 1935
Vedanthangal	Tamil Nadu	Chegai-Anna	SBP, LC, LE, GH PS, OBS, BHI, WSB	1798	Bates, *loc. cit.,* Baker, 1935; Gee, 1964; Hume and Oates, 1890
Koonthakulam	Tamil Nadu	Tirunelveli	SBP, IS, LC, LE, GH, PS, BHI	1900?	Rhenius, Webb-peploe, 1945; Wilkinson, 1961; Johnson, 1971
Sajnakhali	West Bengal	South 24-Parganas	LC, PH, LE, SE, GE, OBS	1930s	Baker, 1935; Hume and Oates, 1890; Law, 1951
Raiganj	West Bengal	West Dinapur	LC, NH, LE, OBS	1960s	Shahi, 1983

* Names refer to information obtained through personal communications.

TABLE 5
TOP 10 HERONRIES IN INDIA

Name of the heronry	State	Number of species	Number of nests	Source*
Telikunchi Village	Andhra Pradesh	1+	25,000	U.N. Dev; Divya Muddappa, B.C. Choudhury
Keoladeo National Park	Rajasthan	16	10,960	Ali, 1953; Vijayan 1991; Sankhala, 1990
Raiganj	West Bengal	6	10,000+	Shahi, 1983
Sajnakhali	West Bengal	7	10,000+	Baker, 1935; Hume and Oates, 1890; Law, 1951
Bhitarkanika Wildlife Sanctuary	Orissa	13?	10,308+	Sudhakar Kar, Bhivash Pandav, pers. comm.
Ranganathittu Bird Sanctuary	Karnataka	16	8,000+	Personal observations
Kumarakam	Kerala	11	5,000+	Hume amd Oates, 1890; Law, 1951; Kumar Chattopadhyay
Nooranad	Kerala	9	5,000+	K. Rafeek, P.K. Uttaman
Luna Village	Gujarat	8	5,000+	Tiwari (1993)
Gudvi Bird Sanctuary	Karnataka	10	5,000+	Ragunatha *et al.*, 1992; Ragunatha, 1993;

* Names refer to information obtained through personal communications.

in India. Only about 7% of the heronries are traditional nesting sites and some of these heronries have been in existence for well over a century. The Kokkare Bellur Pelicanry, Vedanthangal Bird Sanctuary and Koonthakulam Pelicanry in Tamil Nadu are fine examples of this. Though published records indicate that this pelicanry was in existence in 1864 (Jerdon 1864), enquiries with local people indicate that the colony may well be over 500 years old (pers. obs.).

At these sites birds exhibit a strong site tenacity as observed at Ranganathittu Bird Sanctuary after the devastating 1991 floods (Subramanya *et al.* 1991). Similar re-nesting following disturbance has been observed in Spotbilled Pelicans at Kokkare Bellur Pelicanry (pers. obs.). Such a strong attachment to the nesting site should convince the concerned authorities of the importance of these sites for birds, and efforts should be directed to implement long term conservation plans.

Lost sites: The information on sites where birds once nested is scattered through the literature. The majority of these sites referred to in literature (e.g. Ali 1945, 1955, 1960; Annandale 1921, Baker 1935, Barnes 1886, Bates and Lowther 1952, Betham 1904, Bingham 1876, Burnett 1959, Campbell 1902, Guttikar 1979, Ferguson and Bourdillon 1904, Forbes 1967, Hume and Oates 1890, Law 1926) no longer exist. While no information is available on 147 former sites, 26 nesting sites have disappeared due to various reasons (Table 7). The present status of most of the sites that were known to be active until recently (e.g. Singh and Sodhi 1986, Mahabal 1990) is not known.

TABLE 6
SOME OF THE TRADITIONAL NESTING SITES IN INDIA

Name of the site	State	District	Nesting species	Source*
Telineelapuram	Andhra Pradesh	Srikakulam	SBP, PS	Nagulu and Rao, 1983; M.M.L. Kumar
Neelapattu	Andhra Pradesh	Nellore	SBP, LC, LE, GH, OBS, BHI, WSP	Nagulu, 1983; Nagulu and Rao, 1983
Ethirapattu	Andhra Pradesh	Nellore	LC, LE, PS, WSB	Ramakrishna, 1986, V. Nagulu & Joel Prashanth
Subansiri heroney	Arunachal Pradesh	Upper Subansiri	GC	Baker, 1935
Southern Gulf of Kutch heronries	Gujarat	Jamnagar	LC, OD, NH, PH, WRE, GE, GH, PS, BHI, BI, WSP	Naik *et al.,* 1991; Taej Mundkur
New Port Of Bhavnagar	Gujarat	Bhavnagar	PH, WRE, BHI	Naik and Parasharya, 1987, 1991
Khijadhia	Gujarat	Jamnagar	PH, RE, PS, BHI	Naik *et al.,* 1991; Taej Mundkur; Vinod Pandya
Ghoga Town	Gujarat	Bhavnagar	NH, PH, CE, WRE, LE, SE, GE, PS, BHI, WSB	Naik & Parasharya, 1987; I.R. Gaghvi
Ranganathittu	Karnataka	Mysore	GC, IS, LC, OD, NH, PH, CE, SE, GE, PrH, GH, PS, OBS, BHI, WSB.	Neginhal, 1983, Sharatchandra, 1980; Personal observations
Kokkare Bellur Pelicanry	Karnataka	Mandya	SBP, PH, PS, BI	Neginhal, 1976, Sanjay 1993; Personal observations
Gudvi Bird Sanctuary	Karnataka	Shimoga	IS, LC, OD, NH, PH, LE, SE, GE, PrH, BHI, WSB	Ragunatha, 1993, Ragunatha *et al.* 1992, Personal observations
Bhitarkannika Wild-life Sanctuary	Orissa	Cuttack	LC, OD, NH, SE, PrH, GH, OBS, LA	Sudhakar Kar; Vivash Pandey
Keoladeo National Park	Rajasthan	Bharatpur	GC, IS, LC, OD,NH, PH, CE, LE, SE, GE, PrH, GH, PS, OBS, BHI, WSB	Ali, 1953; Sankhala, 1990
Vedanthangal	Tamil Nadu	Chengai-Anna	SBP, LC, LE, GH, PS, OBS, BHI, WSB	Bates, *loc. cit,*. Baker, 1935; Gee, 1964; Paulraj & Kondas, 1987, Santharam & Menon 1991
Koonthakulam	Tamil Nadu	Tirunelveli	SBP, IS, LC, LE, GH, PS, BHI	Rhenius, Webb-peploe, 1945; Wilkinson, 1961; Johnson, 1971; A. Rajaram; G. Padmanaban, G.S. Sanjay, V. Ragunatha

TABLE 6 (CONTINUED)

Name of the site	State	District	Nesting species	Source*
Chitrangudi Heronry	Tamil Nadu	Ramanathapuram	SBP, GC, IS, LC, OD, PH, CE, LE, GE, GH, PS, OBS, BHI, WSB	Ramachandra Raja; G.S. Sanjay, V. Ragunatha
Vettangudi Patti	Tamil Nadu	Ramanathapuram	SBP, LC, OD, PrH, PS, OBS, BHI, BI, WSB	G.S. Sanjay, V. Ragunatha
Sajnakhali Heronry	West Bengal	South 24-Parganas	LC, PH, LE, SE, GE, OBS	Hume and Oates, 1890; Law, 1951; Kumar Chattopadhyay
Raiganj	West Bengal	West Dinapur	LC, NH, LE, OBS	Shahi, 1983

* Names refer to information obtained through personal communications.

The vast swamps of the Brahmaputra floodplain and its associated beels once supported a large number of heronries (Baker 1935, Hume and Oates 1890), but little information is now available on the existence of these old heronries. The nesting sites that were once found within or close to Barpeta Beel, Dhemaji Beel, Dhemaji Village, around Dibrugarh, Goalpara Swamp, Lakhimpur Swamp, Tinsukia, within the floodplain of Brahmaputra river (Baker 1935) do not seem to exist any more. One of the reasons for this may be the changes in land use pattern in the area (Saikia and Bhattacharjee 1993).

Some of the important sites that have been lost over the century include one of the first nesting colonies of Spotbilled Pelican discovered in India by Campbell (1902); the nesting colony of Great White (Rosy) Pelican (Ali 1960, Shivrajkumar *et al.* 1960); a large heronry consisting of Pelicans, Cormorants, Night Herons, Little Egrets, other herons, ibises and Spoonbills at Tangalle and Mathura (Hume and Oates 1890); a large colony of Little Cormorant, Darter, Pond Herons, egrets, Great Egrets, Openbill Storks, Spoonbills nesting in a village in south Mainpuri district (Hume and Oates 1890). Similarly, a large colony of Painted Storks in Deeg town close to Bharatpur, Rajasthan, which had birds nesting on *Acacia nilotica* growing around the fort and market place in the city, is not known (Chatterjee, pers. comm.). Also, the heronries located on the islands of Chilka Lake (Annandale 1921, Forbes 1967) no longer exist (Sudhakar Kar and K. Mohapatra, pers. comm.).

Protected Heronries: The heronry survey has revealed that only a small proportion of the nesting sites receive protection (Table 8). In addition to those protected by Forest Departments, several traditional nesting sites are protected by the local people; a few nesting sites enjoy protection due to their occurrence in religious places (Table 5). By virtue of their location in government office premises or on private properties, some of the heronries are fortunately inaccessible to people who can harm them. Birds at these sites are least disturbed and the threat to nesting birds is minimised. As a consequence, they continue to nest at these sites regularly.

Threats, disturbances and loss of heronries: Continued survival of heronries is threatened by several factors. Table 9 lists factors that threaten and disturb nesting sites. While some of the factors are common to many heronries, a few are specific to individual heronries. Available information shows that nearly 50 sites are threatened by human induced factors; 21 sites are threatened with natural factors (Table 9). Some of the important factors are discussed below:

Destruction of nesting substrate: Felling of

TABLE 7
SOME OF THE IMPORTANT HERONRIES THAT ONCE EXISTED

Name of the Heronry	State	District	Nesting species	Year of last record	Source*
Snake Island	Andamans and Nicobar		ERE	1897	Osmaston (1900); Davison *loc. cit.*, Baker, 1935
Corbyn's Cove	Andamans and Nicobar		ERE	1897	
Cocos Island	Andamans and Nicobar		ERE	1897	
Oyster Island	Andamans and Nicobar		ERE	1930s	Shopland *loc. cit.*, Baker, 1935
Trinkut Island	Andamans and Nicobar		ERE	1930s	Hopwood *loc. cit.*, Baker, 1935
Ongole (?) Pelicanry	Andhra Pradesh	Prakasam	SBP	1873	Hume, 1881
Pullagoorapalli Pelicanry		Cudappah	SBP	1873	
Buchupalle Pelicanry		Cudappah	SBP, PS	1908	Campbell, 1908
Nellore		Nellore	RE	1961	Kirkpatrick, 1961
Godavari village		? Godhavari	PS	1880s	Burges *loc. cit.*, Hume and Oates, 1890.
Kolleru Pelicanry		West Godavari	SBP, LC	1949	Gee, 1960; Neelakantan, 1949
Tinsukia Railway Station	Assam	Tinsukia	Herons, OD, herons, LE, cormorants, IS	1930s	Baker, 1935
Barpeta Heronries		Barpeta	LC, egrets, OBS, GI	1930s	
North Lakhimpur Heronries		Lakhimpur	LC, IS, OD, egrets, bitterns, OBS	1930s	
South Lakhimpur Heronries		Lakhimpur	LC, egrets, bitterns	1930s	
Mornai Village	Assam	Goalpara	PrH	1930s	Hume and Oates, 1890
Kodasheri River	Kerala	Malappuram?	OD	1900s	Ferguson and Bourdillon, 1904
Bird Island (Chilka)	Orissa	Puri	LC, OD	1858-1867	Forbes, 1967
Charriakuda Island (Chilka)			NH, GH	1921	Annandale, 1921
Kalidai Island (Chilka)			LC, IS	1921	
Sambhur Lake	Rajasthan	Nagur	CE	1870s	Adams (Baker 1935, *loc. cit.*)
Deeg	Rajasthan	Bharatpur	PS	1973	Chatterjee
Lucknow (Oudh)	Uttar Pradesh	Lucknow	OBS	1890s	Hume and Oates, 1890
Lohya Bridge (Ganges Canal)	Uttar Pradesh	Etawah	PrH	1867	Hume and Oates, 1890

TABLE 7 (Continued)

Name of the Heronry	State	District	Nesting species	Year of last record	Source*
Village Kupser	Uttar Pradesh	Lucknow?	OBS	1861	Irby, 1861
Govardhan (Goburdhum)	Uttar Pradesh	Mathura	PS	1860-1930	Hume, Lindsey Harvey *loc. cit.*, Baker, 1935.
Etawah Graveyard	Uttar Pradesh	Etawah	PH, CE, ME	1856-1866	Hume and Oates, 1890
Umraha Village	Uttar Pradesh	Allahabad	OBS	1890s	Hume and Oates, 1890
Mohar	Uttar Pradesh	Kanpur	BHI, OBS	1890s	Hume and Oates, 1890
Tangalle and Mathura	Uttar Pradesh?	Mathura?	Egrets, Herons, BHI, WSB	1890s	Layard *loc. cit.*, Hume and Oates, 1890
South Mainpuri (Karhal?)	Uttar Pradesh	Mainpuri	LC, OD, PH, egrets, GE, OBS, SPB	1880s	Hume and Oates, 1890
Gorakhpur	Uttar Pradesh	Gorakhpur	GA	1830s	Baker, 1935

* Names refer to information obtained through personal communications.

nesting trees in heronries is a serious factor that contributes to the loss of nesting space. A property dispute over a large *F. benghalensis* tree that used to support about 100 nests led to its felling (Sridhar 1992) and the author's personal observation corroborates the same. Similarly, felling of a *F. religiosa* tree near Mathikere Heronry led to the shifting of the colony to a nearby *F. benghalensis* tree (pers. obs.). The heronries at Ulloor, Vattapara in Trivandrum are lost due to the loss of nest substrate (C. Susanthakumar, pers. comm.).

Destruction of nesting substrate is a major factor contributing to the loss of heronries. As a part of the social forestry program, the foreshore stands of *A. nilotica* were harvested to distribute benefits to the people (Wilson 1986). Heronries at several tanks (Table 10) were destroyed when the *A. nilotica* stand was clear felled (S. Vasuki, pers. comm.). Similarly, at a tank located about 30 km from Coimbatore on the road to Satyamangala, the *A. nilotica* stand which supported a large colony of Little Cormorants and Little Egrets was gradually cut down in 1982 (S.T. Bhaskaran, pers. comm.). The heronry at Rathanpur Jheel close to Ahmedabad was destroyed similarly (Satkopan, pers. comm.). At Kandla Creek, in the Gulf of Kutch, over-exploitation of mangroves has resulted in the disappearance of the heronry that once existed (Ali 1945, Parasharya, pers. comm.). The loss of heronries at several tanks (Abraham 1973) may have been due to the same reason.

The nesting of waterbirds in large colonies is often associated with the offensive smell due to defecation and rotting of fish scraps fallen from the nests. The resulting stench is offensive to people living close by. At Ulloor Heronry in Trivandrum, the nesting tree was cut down by its owner to escape the stench of nesting birds during the monsoon (C. Susanthakumar, pers. comm.). For the same reason, the Vattapara Heronry in Trivandrum was destroyed (C. Susanthakumar, pers. comm.) and the KTC Bus Stop Heronry in Palakkad is threatened.

Developmental activities are often not in favour of nesting birds. A number of heronries have disappeared due to removal of nesting substrate or disturbance consequent to developmental activities.

TABLE 8
STATUS OF PROTECTED HERONRIES IN INDIA

Nature of protection	Number of sites	Per cent sites	Examples
State	42	11.86	Bhitarakanika, Keoladeo National Park, Neelapattu, Sajnakhali, Raiganj, Ranganathittu, Vedanthangal
People	7	1.97	Kokkare Bellur, Koonthakulam, Telineelapuram
Religious sites	9	2.54	Gadhula Village, Gourikoppa Village, Khara Chusna Island, Pirotan Island
Positional effect	8	2.30	Basaveshvarnagar, Ghoga Town, Kadakkal, Indapur, New Port of Bhavnagar, Railway colony Jodhpur, Simpson Estate
Total	66	18.67	

Heronries in different parts of Madras (Krishnan 1979) seem to have disappeared due to development of the city (Santharam, pers. comm.). Similarly, the Salt Lake Colony of Purple Herons in Calcutta (Saha 1969) seems to have disappeared due to developmental activities.

In Assam, a recent search for the nesting colony of egrets which Burnette (1958) photographed in Sibsagar district revealed that over the years, the growth of residential colonies around the site led to the dwindling of the bamboo grove. In 1993, a search for the site yielded only a few culms of bamboo at the site which was once a vast grove that supported a colony of over 200 nests of Cattle and Little Egrets. The birds had abandoned the nesting site nearly 20 years ago owing to clear cutting of bamboo (Deeptimanta Barooah, pers. comm.).

TABLE 9
THREATS AND DISTURBANCES TO HERONRIES

Type of threat or disturbance	No. of sites Affected	Lost
Destruction of nesting substrate	3	13
Poaching nestlings/adults	10	2
Human activity	12	—
Predation	11	—
Natural calamities	1	6
Damage to nesting substrates	4	1
Egg gathering	4	—
Lack of suitable foraging areas	—	2
Draining of wetland	—	1
Defoliation of nest tree	—	1
Electrocution	1	—
Rock Bee havoc	1	—

At Moondradaipu, several roadside trees being used by Spotbilled Pelican, Little Cormorants and Painted Storks (Ganguli 1964) were cut down over the years. Subsequently, the nesting site was abandoned by birds in 1989 after a chemical factory was built close by. Following this, the remaining trees were also cut down (Rajaram, pers. comm.).

The Night Heron appears to be very sensitive to disturbance in and around its nesting colony. A large nesting colony of the species at Malleswaram, Bangalore, was abandoned during the early 1970s, following the construction of buildings close by. Such colonies are rarely permanent and in Bangalore the birds have been observed to shift their nesting colonies within a locality. Some of the sites are occupied for a single nesting season.

Damage to nesting substrates: Local fuel and fodder requirement may result in the exploitation of trees used for nesting by birds in heronries. At some of the heronries in the Southern Gulf of Kutch (Bhaider, Nora, Chank, Ghandhiya Kodo and Kalubhar island heronries), fishermen living close to some of the islands frequently lop the nesting substrates for fuel (Naik *et al.* 1991). At Kokkare Bellur, some of the trees utilised by birds are lopped regularly by the local people to provide fodder for their goats. As a consequence, the crowns of these trees get severely deformed, thus reducing the

available nest space to birds. This results in the falling out and subsequent loss of nestlings from their nests (Subramanya and Manu 1996). Also, damage to nesting substrates occurs due to developmental activities. At Morvi Town Heronry, the branches of most of the trees used for nesting were pruned in 1987 for the construction of a water tank, leading to the loss of nesting substrate (Taej Mundkur, pers. comm.) and at Gandhiya Baug heronry where bamboo clumps used for nesting by birds were chopped down by the Surat town municipality in 1993 (Sneha Patel, pers. comm.).

Disturbance to nest site: Disturbances to the nesting colony either by human activity or other factors could lead to the abandonding of the nesting site. For example, the Little and Cattle Egrets were nesting on a huge *F. mysorensis* tree found on the island in the middle of the crocodile pond at Jodhpur Zoo. The birds abandoned the site a few years back, after the construction of a bridge linking the island with the mainland, for easy movement of caretakers. As a consequence, semi-feral cats started predating on the nestlings. In addition, the slaughter of animals to feed the carnivores at the zoo started attracting crows and pariah kites which also predated on the contents of unattended nests. All these factors led to the abandoning of the nesting site (Indra Kumar Sharma, pers. comm.). Till 1979, Pond Herons were nesting on shrubs growing on the island in Lalbagh Tank at Bangalore. Clearing of these natural dense shrubs and construction of a land bridge led to the disappearance of the nesting colony (pers. obs.).

Poaching: Poaching of eggs, nestlings and even the nesting birds is a serious threat to the survival of heronries. At Gudvi Bird Sanctuary, poaching of eggs and nestlings was rampant and the size of the nesting colony dwindled till the site received official protection (Raghunatha *et al.* 1992). Nagulu (1993) indicates that poaching was one of the factors that led to abandoning of Kolleru Pelicanry. At Panidihing Heronry, hunting parties regularly raid the nesting colony and steal eggs.

Effect of natural calamities: Natural calamities like floods and cyclones damage heronries to different degrees, and droughts lead to failure of nesting at the site. Floods can be devastating to heronries located amidst rivers or in the floodplains (Neginhal 1980). For example, at Ranganathittu Bird Sanctuary, where birds nest on tree-studded islands midstream of a swift flowing river, flash floods during 1991 raised the water level at the sanctuary by 5 m. The surging waters submerged or washed away ten of the eleven islets, along with the nests built within the five metre level, while the vegetation on some islets was uprooted. A few islets overgrown with screwpine (*Pandanus* sp.) were devegetated. Whatever vegetation withstood the fury of flood was deposited with debris, choking the available nest-space.

Cyclonic storms are often very destructive to heronries. At Ethirapattu Heronry, a huge tamarind tree was uprooted and the side branches of most of the trees were broken (K.Mruthunjaya Rao). Ramakrishna (1990) reports that the side branches of most of the trees were broken in addition to uprooting a huge tamarind tree. When a Neem tree on which Openbill Storks were nesting at Tsunduru Village Heronry was affected by a cyclone in 1990, the birds successfully shifted over to nest on *Polyalthia longifolia* found close by (K. Mruthunjaya Rao, pers. comm.). However, when Jagrugumilli Village Heronry in Prakasham district was hit by a cyclone in 1979, the nesting birds shifted to Patchava Village (K. Mruthunjaya Rao, pers. comm.).

A thunderstorm destroyed the crown of an *Acacia nilotica* tree in Cuddapah city during 1989 and the Pond Herons, Cattle Egrets and Little Egrets which had been nesting on it abandoned the site (Riazuddin, pers. comm.). When the Reef Heron colony at the New Port of Bhavnagar was severely hit during the cyclonic storm in November 1982, a large number of herons were stunned by shock and cold (Naik and Parasharya 1987). The cyclone of 1984 that swept through Neelapattu Sanctuary uprooted a number of nesting trees and resulted in the mortality of a large number of birds (Tehar 1985).

Droughts prevent breeding at traditional colonies in very dry years (e.g. Keoladeo National Park: Ali 1979, Breeden and Breeden 1982, Verghese *et al.* 1982; Vedanthangal: Paulraj 1984, Santharam,

pers. comm.; Mainpuri: Hume and Oates 1890). The nesting of birds at Rozi Island and Khijadia Bird Sanctuary is totally dependent on the adequate rainfall received during monsoon (Naik *et al.* 1991). The level of water and the time span during which the water collects in the pond harbouring the nesting tree, is crucial for the nesting of birds. During 1988 and 1989, the monsoon was very good and breeding progressed smoothly. However, due to the failure of monsoon during 1990, the ponds dried up early and the birds did not nest at the site (Naik *et al.* 1991).

Some threats could be peculiar to certain specific sites. At Hebbal in Bangalore, a colony of Night Herons, which had started nesting on *F. religiosa* abandoned the site when the tree shed its leaves during February (pers. obs.). In Kokkare Bellur Pelicanry, a few adult and nestlings of Spotbilled Pelican and Painted Storks die each year after colliding with a 10,000 volt electricity cable that passes through the village where birds nest (pers. obs.). In another situation at the Mathikere Heronry, colonies of Rock Bee *Apis dorsata* share the large trees used by nesting birds. On several occasions, clambering fledglings of birds have bumped into the hives, enraging the bees. In 1993, the villagers of Mathikere observed about 30 very young nestlings of Little Cormorants, Night Heron and Grey Herons being stung to death by enraged bees. The bees stung the bare parts of the nestlings which were unable to fly. Nestlings which were severely stung died after their fall from the canopy.

Conservation of heronries: While a number of heronries are lost (Fig. 4) due to various reasons, only a small percentage of the existing nesting sites are protected. While protecting heronries should be an important conservation issue, the problem is not as simple as protecting a specific heronry. It appears that selection of a specific nesting habitat by these birds is more complex than merely occupying what is usually termed as '*a safe nesting site*'. The choice of a specific nesting site appears to be based mostly on the availability of suitable feeding conditions at a chosen site (Bancroft *et al.* 1988, Carrascal *et al.* 1993, Gibbs *et al.* 1987, Venkataraman and Muthukrishnan 1993) and also the availability of suitable nesting conditions in a specific locality that has the feeding conditions. These two factors appear to be inseparable (Ali and Ripley 1987, Naik *et al.* 1991). The survival of a heronry depends, in addition to the availability of safe nesting sites, on the continued availability of suitable feeding conditions. Thus, at each site chosen for protection, important feeding sites where the nesting birds forage need to be identified and efforts should be directed at protecting them. Observations at Kokkare Bellur Pelicanry have shown that the nesting pelicans and Painted Storks travel as far as 60 km to forage (Sanjay 1993, Subramanya and Manu 1996). The feeding sites comprise of over 150 tanks of varying sizes ranging from less than 10 ha. to more than 100 ha. in area. These tanks, in effect seem to form a feeding habitat complex which supports the nesting population of birds at Bellur.

On the other hand, providing protection to a greater number of heronries against disturbance and habitat destruction, clearing or felling of nest-substrates should be an important strategy to ensure continued survival of heronries. By taking into consideration the types of threats and disturbances affecting heronries (Table 9), several conservation options can be considered. Some of the important options are discussed below:

Bringing more Heronries under State Protection: At present only a few heronries enjoy state protection. Any conservation strategy thus should aim to increase the number of sites coming under state protection. For this, there is an urgent need to identify all promising nesting sites, officially declare them as protected and initiate conservation activities.

Total protection from every form of threat or disturbance: As discussed earlier, one of the major causes for the loss of the nesting sites is the loss of favoured nesting substrate through habitat destruction. Failure to replace the substrate with similar features worsens the situation. Even in protected sites, very little effort is being made to correct the situation. The existing nesting substrate within such sites should be protected from destruction and loss, and concrete steps taken to

ensure the adequate future availability of nesting substrate.

Often, the loss of nesting substrate at heronries is tied to local timber, fuel and fodder requirements. An alternate strategy, backed by a strong social forestry programme, should be formulated to meet these local requirements (Subramanya and Manu 1996).

Protection of Roost Sites of large Waterbirds: In many instances, former roost sites have eventually developed into nesting sites. Safety appears to be a key factor promoting the nesting at a former roost site. The occurrence of both roost and nesting sites appears to be governed by two major factors, namely safe sites providing suitable roosting or nesting substrates and the availability of suitable feeding habitat conditions. Prolonged safety from disturbances at a given roost site appears to tempt birds to utilise the same site for nesting. In fact, several heronries have begun as roost sites (Table 10). For example, the banyan tree on which the birds nest at Basaveswarnagar Heronry is located in an isolated corner of an enclosed government office property, where even the employees seldom wander. The site is totally free from disturbance. Birds nesting in heronries seem to have recognized this (pers. obs.).

TABLE 10
HERONRIES THAT COMMENCED AS ROOST SITES

Name of the site	Roosting species	Nesting species
Hebbal	NH	NH
Basaveswaranagar	LC, NH	LC, NH
Malleswaram	NH	NH
Karanji Tank	OD, GC, PS, WSB	OD, GC, PS,
Soolekere	PS, WSB	PS, WSB
Simpson Estate	LC, IS, OD, LE, CE, RE, ME, GE, GH, BHI, WSB	LC, IS, OD, NH, LE, ME, GE
Madurai City	PH	PH
Pudhugramam	CE	CE
Udayamarthanda-puram	GC, IS, LC, OD, NH, PH, CE, LE, GH, PS, OBS, BI, WSB	GC, IS, LC, OD, NH, PH, CE, LE, GH, PS, OBS, BI, WSB
Kumarakam	GC, IS, LC, OD, NH, PH, LE, SE, GE, PrH	GC, IS, LC, OD, NH, PH, LE, SE, GE, PrH
Peppara	GC, LC, IS, OD	LC
VC Farm	LC, PH, LE, CE	PH, LE, CE
Gourikoppa Village	LC	LC

Similarly, the Simpson Estate Heronry in Madras started as a roost site of night herons in the early 1960s. When this roost site received total protection from any form of threat the birds started nesting there. Nearly 11 species making up a population of over 10,000 birds roost at the site and nearly 2,000 nesting birds comprising six species nest at the site today (V.Gurusamy, pers. comm.). Thus, identifying large roost sites of colonial waterbirds and according to them official protection may help nesting in the long run.

Increasing Nesting Substrate Availability: Tree nesting is an important feature among the birds nesting in heronries (Table 2) and in nearly 96 per cent of the sites, trees form the nesting substrates. Loss of trees, as discussed earlier, may be a potential threat resulting in the loss of nesting substrate. As both natural and human influenced factors may affect the availability of trees, it is worthwhile, in addition to protecting existing trees at the site, to ensure future availability of trees for nesting. To achieve this, regular planting of preferred tree saplings is necessary in and around the heronries. These saplings have to be protected from damage till they attain sufficient height. The *A. nilotica* trees planted following the 1984 cyclone at Neelapattu Bird Sanctuary have compensated some of the lost nesting substrate (Nagulu, pers. comm.).

Creation of heronries: Understanding the factors leading to the formation of heronries is useful in deciding on the ways and means of making conditions conducive to nesting at a particular site. Table 11 lists the number of situations where several factors have favoured the starting of a new colony.

Though heronries have to commence at some point of time, the process of selection of nesting site appears to be operating at two levels. To begin with, the area that affords good and suitable feeding conditions is selected and then within this area, a

TABLE 11
FACTORS FAVOURING THE COMMENCEMENT OF HERONRIES

Favouring factors/mode	No. of sites
Foreshore afforestation of tanks	14
Tree trunks in the backwaters of dams	6
Protection of roost sites	10
Suitable conditions in an aviary	3
Afforestation	1
Ideal feeding conditions	2

suitable site that affords sufficient safe nesting substrate is selected (Fasola and Alieri 1992, Fredrick 1989, Gee 1964, Gibbs 1991, Hafner and Fasola 1992, Kushlan 1976). For example, at Kokkare Bellur Pelicanry, studies revealed that birds frequent medium to large tanks located within about 60 km around the nesting site (Sanjay 1993, Subramanya and Manu 1996). Observations indicated that the village was one of the few that had a high tree density. Within the village nesting birds utilize over 100 trees out of nearly 220 trees found within the village (pers. obs.). The nesting birds were safe within the village as they were protected by the sentiments of local people (Neginhal 1993).

While the availability of suitable sites for nesting and feeding are essential to establish heronries, several factors contribute towards meeting the nest site requirements. Though it is not always possible to identify these contributing factors, there are certain situations where it is possible to identify several factors that have favoured the commencement of nesting (Table 12).The influence of some of these factors is discussed below:

Foreshore Afforestation of Tanks: Tamil Nadu Factor: The popular view on the existence of heronries is that these sites are traditional breeding grounds for the birds which have been nesting since a long time. This is true, when one considers sites like Vedanthangal, Koonthakulam, Telineelapuram, Kokkare Bellur, where birds are known to be nesting for a long time (Table 4). However, the

TABLE 12
LIST OF TANKS IN TAMIL NADU WHERE HERONRIES CAME INTO EXISTENCE FOLLOWING FORESHORE AFFORESTATION WITH *Acacia*

District	Name of the tank
Ramanathapuram	Vettangudi
	Chitrangudi
	Kanjeerankulam
	Sakarakotti Konmoi (L)*
	Parai Konmoi (L)
	Cheluvanoor (L)
	Pillayarkulam (L)
	Komboothi (L)
Kanyakumari	Suchindramkulam (L)
	Theroorkulam (L)
	Manakudi Tank (L)
Tirunelveli	Koonthakulam Tank
Periyar	Vellode-Periakulam Tank
	Kangurkulam

* Those marked (L) no longer exist.

commencement of heronries in Ramanathapuram and Tirunelveli districts of Tamil Nadu in mid 1960s (Table 12) indicate that man can help in the creation and establishment of these heronries. In 1960, the Social Forestry Programme, Tamil Nadu Forest Department started foreshore afforestation of a large number of tanks with *A. nilotica* (Wilson 1979). Once the *Acacia* saplings grew to form a dense stand of trees that invariably became partially submerged after monsoon inundation, it provided safe and ideal conditions for the nesting of colonial water birds. The heronries at Vettangudi, Chitrangudi, Kanjeerakulam, Koonthakulam and Vedamugam-Vellode Tank commenced after foreshore afforestation. At Pandoli Tank also, birds started nesting subsequent to the creation of congenial conditions by planting of *A. nilotica* in the foreshore region (R.B. Balar, L.M. Ruol and P.S. Thakker, pers. comm.).

Effect of partially submerged nesting substrates: The creation of large irrigation projects has helped the nesting of large waterbirds (Table 5). Their creation in forested river valleys is often associated with the submergence of a considerable extent of forest in the foreshore region, resulting in dead tree trunks standing partially submerged in water. As water acts as an insulating factor around nesting trees against ground predators (Gee 1964), such sites have attracted Darters and Large Cormorants for nesting (Nair and Nair 1973, Nair 1996). In Karnataka, a colony of nearly 500 pairs of Great Cormorants and a few Darters are known to nest on bare tree trunks standing in the backwaters of Kabini Reservoir (Ullas Karanth, pers. comm.).

Partially submerged trees in a large waterbody appear to have been the most preferred nesting substrate for colonial nesting waterbirds. In Gujarat, for example, every reservoir providing such nesting substrates (e.g. Aji-II, Aji-III, Sardhar Reservoir, Mithikhari Reservoir, Nayri Reservoir and Kalaghoga Reservoir), invariably seem to support a heronry. Thus, trees growing either close by or partially submerged, in the shallower regions of the reservoir should be able to attract waterbirds for nesting. (e.g. Nair and Nair 1973, Nair 1996).

Effect of large waterbodies: Creation of large waterbodies seems to have been crucial in the commencement of heronries in the surrounding areas. All the major heronries in inland Kerala are located close to major reservoirs and undoubtedly they appear to have come into existence after the construction of these waterbodies that provide them with crucial feeding habitats. Once the conditions amenable for nesting (feeding and nest-site) are created, one can expect birds to start nesting close by soon.

Attraction of tree covered islands for nesting waterbirds: Dense vegetation covered islands in the midst of flowing rivers or large waterbodies have a considerable attraction to nesting birds. The best examples for such heronries are the Ranganathittu, the islands in the Southern Gulf of Kutch, Jodhpur Zoo and Hemisar Tank Heronry. Construction of tree studded islands (mounds planted with *A. nilotica* amidst the wetland) at Keoladeo National Park, has indeed proven that birds readily colonise them (Sankhala 1990). At Kukkralli Tank Heronry in Mysore Pelicans, Darters, Painted Storks and Spoonbills colonised a tree covered island in the middle of the tank, when drought affected their nesting habitat at Karanji Tank about 5 km away (K. Manu, pers. comm.).

Considering the influence of the above factors in the commencement of heronries, efforts should be made wherever possible to create conditions, as discussed above, suitable for the nesting of large waterbirds.

Establishing nesting colonies in Aviaries: By providing suitable nesting substrates and an assured food supply, it is possible to induce large waterbirds to breed within the confines of large aviaries. In the Bannerghatta National Park Aviary near Bangalore, it has been possible to establish nesting colonies of Spotbilled Pelican, Little Cormorant, White Ibis and Spoonbill (Venkatesh *et al.* 1996). Birds have been observed to breed in similar situations at Vandalur Zoo in Tamil Nadu, Nehru Zoological Park in Hyderabad and Baroda Zoo (Santharam, Aasheesh Pittie and Geeta Padati, pers. comm.)

Involvement of local people: Available information on heronries in India reveals that nearly 80% of the heronries are located within or close to human habitation and in rural settings. To protect these sites, it is important to involve local people living close to nesting sites. Efforts have to be directed at educating and convincing them of the need to protect the nesting sites. Programmes have to be started to actively involve them in conservation activities. In fact, such an exercise has led to the formation of a "*Hejjarle Balaga*", the Village Pelican Conservation Group at Kokkare Bellur Pelicanry in Karnataka (Subramanya and Manu 1996). Efforts should also be made to encourage local non-governmental organisations to identify heronries and work towards protecting them in association with the concerned government departments.

Conclusion

Available information shows that much can be done to identify and protect potential heronries in different parts of India as the future of heronries depend much on protecting existing sites and on the quality of protection given to them. Concerted efforts in this direction through regional cooperation of agencies and concerned individuals in different parts of India can help in establishing a network of heronries. Towards this end, there is a need to develop a more detailed inventory of heronries at the district or state level by concerned individuals or by government and non-governmental organisations. This should be followed by bringing more sites under protection.

A comparison of Tables 4, 5 and 6 shows that the age and size of the heronry and the number of species nesting in a colony appears to be related. In other words, the colony size and its species composition grows with time. Thus, it becomes evident that long term protection of nesting sites against every form of threat and disturbance (Table 9) coupled with an increased availability of nesting substrates over the years would go a long way in conserving heronries. It should be kept in mind that man can indeed help in the establishment of heronries by creating conditions facilitating the nesting of waterbirds in select situations.

Further, much can be achieved by creating awareness among the public regarding the importance of these sites and the need to protect them. Especially in instances where the nesting sites are located in private properties, the owners have to be convinced of the importance of such sites and encouraged to protect them through their active participation.

Acknowledgements

This study is one of those few which have been made possible by the whole hearted support of many bird enthusiasts, especially due to their willingness to share information. This task of compiling information on heronries would not have been possible but for the co-operation of a large number of birdwatchers, ornithologists and naturalists who responded to my information request. I feel much obliged by their patience in answering my queries. Space does not permit me to mention all their names and I thank each and everyone of them. Special mention must be made of Lavkumar Khacher, Asad Rahmani, Taej Mundkur, P.S. Thakker, Dhilas Jeffri, A. Rajaram, V. Santharam, Lalitha Vijayan, R.G. Soni, B.M. Parasharya, Abdul J. Urfi, Christian Perennou, Anwaruddin Chouhdury, P.C. Bhattacharjee, Prasanth K. Saikia, Diptimanta Barooah, Shanthilal Varu, Jugal Kishor Tiwari, K. Mruthunjaya Rao, K. Manu, V. Nagulu, V. Gurusami, Debojit Phukan, Kulajyothi Lahkar, Bhupen Das, Soumyadeep Datta, C. Susanthakumar, K. Rafeek and J. Praveen for their help and cooperation. This study was partly supported by the Small Conservation Grant from the Oriental Bird Club, U.K. Lastly, this study would not have been possible without the support of my wife, Meena, especially for having put up with all my idiosyncrasies during this study.

References

Abdulali, H. (1962): An ornithological trip to the Gulf of Kutch. *J. Bombay nat. Hist. Soc. 59*: 655-658.

Abraham, S. (1973): The Kanjirankulam breeding bird sanctuary in the Ramanad District of Tamil Nadu. *J. Bombay nat. Hist. Soc. 70*:549.

Ali, S. (1943): The Birds of Mysore. *J. Bombay nat. Hist. Soc. 44*: 206-220.

Ali, S. (1945): The Birds of Kutch. Oxford University Press, Bombay.

Ali, S. (1954): The Birds of Gujarat. Part II. *J. Bombay nat. Hist. Soc. 52*: 374-458.

Ali, S. (1953): The Keoladeo Ghana of Bharatpur (Rajasthan). *J. Bombay nat. Hist. Soc. 51*: 531-536.

Ali, S. (1960): 'Flamingo City' revisited: nesting of Rosy Pelican (*Pelecanus onocrotalus* Linnaeus) in Rann of Kutch. *J. Bombay nat. Hist. Soc. 57*: 412-415.

Ali, S. (1979): Keoladeo Ghana waterbird Sanctuary. *Hornbill 13*: 27-29.

ALI, S. & S.D. RIPLEY (1987): Compact Handbook of the Birds of India and Pakistan. Oxford Univ. Press, Bombay.

ANNANDALE, N. (1921): The birds of Barkuda Island. *In*: The fauna of an island in Chilka Lake. Part I. *Records of Indian Museum 22*: 323-333.

BADSHAH, M.A. (1963): Breeding colony of Painted Storks. *Peacock 3*: 15-17.

BAKER, E.C.S. (1935): The nidification of birds of the Indian Empire. Vol. 4. Tylor and Francis, London.

BANCROFT, G.T., J.C. OGDEN & B.W. PATTY (1988): Wading bird colony formation and turnover relative to rainfall in the corkscrew swamp area of Florida during 1982 through 1985. *Wilson Bull. 100*: 50-59.

BARNES, H.E. (1886): Birds nesting in Rajputana. *J. Bombay nat. Hist. Soc. 1*: 38-62.

BARNES, H.E. (1891): Nesting in Western India. *J. Bombay nat. Hist. Soc. 6*: 130-153.

BAROOAH, D. (1991): Greater Adjutant Storks nesting in Upper Assam. *Newsletter for Birdwatchers 31 (1&2)*: 11.

BATES, R.S.P. (1929): A reed-bed in the Dal Lake, Kashmir. *J. Bombay nat. Hist. Soc. 33*: 656-666.

BATES, R.S.P. & E.H.N. LOWTHER (1952a): Breeding birds of Kashmir. Oxford Univ. Press, London. 367 pp.

BATES, R.S.P. & E.H.N. LOWTHER (1952b): The history of bird photography in India. *J. Bombay nat. Hist. Soc. 50*: 779-784.

BETHAM, R.E. (1904): Notes on birds nesting from Poona. *J. Bombay nat. Hist. Soc. 15*: 709-712.

BETTS, F.N. (1937): Wanted information about heronries in South India. *J. Bombay nat. Hist. Soc. 39*: 183.

BHAT, H.R., P.G. JACOB & A.V. JAMGAONKAR (1992): Observations on a breeding colony of Painted Stork *Mycteria leucocephala* (Pennant) in Anantapur Dist., Andhra Pradesh. *J. Bombay nat. Hist. Soc. 88*: 443-445.

BINGHAM, C.T. (1876): *Anastomus oscitans. Stray Feathers 4*: 212-214.

BOLSTER, R.C. (1923): Notes on the breeding season of the Painted Stork (*Pseudotantalus leucocephalus*). *J. Bombay nat. Hist. Soc. 29*: 561.

BREEDEN, S. & B. BREEDEN (1982): The drought of 1979-1980 at the Keoladeo Ghana Sanctuary, Bharatpur, Rajasthan. *J. Bombay nat. Hist. Soc. 79*: 1-37.

BURGER, J. (1981): A model for evolution of mixed-species colonies of Ciconiiformes. *Quart. Rev. Biol. 56*: 143-167.

BURNETT, J.H. (1959): Photographing a colony of egrets (*Bubulcus ibis* and *Egretta garzetta*) in Assam. *J. Bombay nat. Hist. Soc. 55*: 565-566.

CAMPBELL, W.H. (1902): Nesting of Grey Pelican (*Pelecanus*) in Cudappah District, Madras Presidency. *J. Bombay nat. Hist. Soc. 14* :401.

CARRASCAL, L.M., L. M. BAUTISTA & E. LÁZARO (1993): Geographical variation in the density of the White Stork *Ciconia ciconia* in Spain: Influence of habitat structure and climate. *Biol. Conserv. 65*: 83-87.

CHANGKAKATI, H.C. & R.K. DAS (1991): Nesting habitat of Greater Adjutant Stork. *Indian Forester 117*: 892-895.

CHAUDHARI, A.B. & K. CHAKRABARTI (1973): Wildlife biology of Sundarbans forests. A study of the birds of Sundarbans, with special reference to the breeding of Openbilled Stork, Little Cormorant and Large Egret. *Sci. Culture 39*: 8-16.

CHHAYA, Y.H. (1980): Breeding colony of waterbirds near Seelaj. *Newsletter for Birdwatchers 20 (4)*: 12-13.

CHOUDHURY, A. (1993): Nesting colonies of Greater Adjutant Storks in Naogon and Sibsagar districts of Assam. *Newsletter for Birdwatchers 33*: 47-48.

CRIVELLI, A.J. & R.W. SCHREIBER (1984): Status of Pelecanidae. *Biol. Conserv. 30*: 147-156.

DANIEL, P. (1980): Koondakulam Heronry. *Hornbill 1980 (4)*: 3.

DAS, R.K. (1991): Assam: the main breeding ground of Spotbilled Pelican. *Newsletter for Birdwatchers 31*: 12-13.

DATTA, S. (1996): Birdwatching at Dibru-Saikhowa Wildlife Sanctuary. *Newsletter for Birdwatchers 36: 51-53.*

DATTA, T. & B.C. PAL (1990): Space partitioning in relation to nesting among six bird species in the heronry at Kulik Bird Sanctuary, West Bengal. *Environ. Ecol. 8*: 86-91.

DATTA, T. & B.C. PAL (1993): The effect of human interference on the nesting of Openbill Stork *Anastomus oscitans* at the Raiganj Wildlife Sanctuary, India. *Biol. Conserv. 64*: 149-154.

FASOLA, M. & R. ALIERI (1992): Conservation of heronry Ardeidae sites in north Italian agricultural landscapes. *Biol. Conserv. 62*: 219-228.

FERGUSON, H.S. & T.F. BOURDILLON (1903-04): The Birds of Travancore with notes on their nidification. 4 parts. *J. Bombay nat. Hist. Soc. 15*: 249-264, 455-474, 654-673; *16*: 1-18.

FORBES, G.S. (1967): From the past: Wildlife in Canara and Ganjam. *Hornbill Newsletter* (March-April): 5-6.

FREDRICK, P. & M.W. COLLOPY (1989): Nesting success of five ciconiiformes species in relation to water conditions in the Florida Everglades. *Auk 106*: 625-634.

GANGULI, U. (1964): Pelicans breeding at Moontadaippu. *Newsletter for Birdwatchers 4 (8)*: 1-2.

GANGULI, U. (1975): A Guide to the Delhi Area. Indian Council for Agricultural Research, New Delhi.

GEE, E.P. (1960): The breeding of Grey or Spotbilled Pelican (*Pelecanus philippensis philippensis* Gmelin). *J. Bombay nat. Hist. Soc. 57*: 245-251.

GEE, E.P. (1964): The wildlife of India. Collins, London.

GIBBS, J.P., S. WOODWARD, M. HUNTER & A.E. HUTCHINSON (1987): Determinants of Great Blue Heron Colony distribution in coastal Maine. *Auk 104*: 38-47.

GIBBS, J.P. (1991): Spatial relationships between nesting colonies and foraging areas of Great Blue Herons. *Auk 108*: 764-770.

GUTTIKAR, S.N. (1979): Lost pelicanry. *J. Bombay nat. Hist. Soc. 75*: 482-484.

HAFNER, H. & M. FASOLA (1992): The relationships between feeding habitat and colonially nesting Ardeidae. *In*: Managing Mediterranean Wetlands and their birds. pp. 194-201. IWRB, U.K.

HUME, A.O. & E.W. OATES (EDS.) (1889-1890): Nests and eggs of Indian birds. II ed. Vol. 3. R.H. Porter, London.

HUSSAIN, S.A. & R.D. ROY (1993): Directory of Indian Wetlands. WWF India, New Delhi and AWB, Kuala Lumpur.

IRBY, L.H. (1861): Notes on birds observed in Oudh and Kumaon. *Ibis 3*: 217-251.

JAMGAONKAR, A.V., P.G. JACOB, S.N. RAJAGOPAL & H.R. BHAT (1994): Records of new breeding colonies of Painted Stork *Mycteria leucocephala* in Karnataka. *Pavo 32*: 59-62.

JERDON, T.C. (1864): The Birds of India. Vol. 2. Calcutta: Published by the author.

JOHNSON, J.M. (1971): The heronry at Koonthakulam, Tirunelveli district, Tamil Nadu. *Newsletter for Birdwatchers 11 (8)*: 1-3.

KIRKPATRICK, K.M. (1961): The Ashy Reef Heron *Egretta gularis* (Bosc.) on the east coast. *J. Bombay nat. Hist. Soc. 58*: 275.

KREBS, J.R., (1978): Colonial nesting in birds, with special reference to the Ciconiiformes. *In*: A. Sprunt, J. Ogden, and S. Winkler (eds.), *Wading Birds* (Natl. Audub. Soc. Res. Rep. No. &), pp. 299-314. National Audubon Society, New York.

KRISHNAN, M. (1980) The availability of nesting materials and nesting sites as vital factors in gregarious breeding of Indian water-birds. *J. Bombay nat. Hist. Soc. 77*: 1143-1152.

KUSHLAN, J.A. (1976): Site selection for nesting colonies by the American White Ibis *Eudocimus albus* in Florida. *Ibis 118*: 590-593.

LAW, S.C. (1926): The nesting of Openbilled Stork (*Anastomus oscitans*) in Purulia, Manbhum District. *J. Bombay nat. Hist. Soc. 31*: 223-224.

LAW, S.C. (1951): A Sunderban heronry. *J. Bombay nat. Hist. Soc. 49*: 792-793.

LUDWIG, J.A. & J.F. RENOLDS (1988): Statistical Ecology: A primer on methods and computing. John Wiley & Sons, New York.

MAHABAL, A. (1990): Heronries in Raigad District, Maharashtra - a preliminary survey. *J. Bombay nat. Hist. Soc. 87*: 137-138.

MUKHERJEE, A.K. (1959): Pakhiral, Sajnakhali - An introduction to a bird sanctuary in the Sunderbans. *J. Bengal nat. Soc. 30*: 161-165.

MUKHOPADYAYA, A. (1980): Some observation on the biology of the Openbill Stork *Anastomus oscitans* Boddaert in southern Bengal. *J. Bombay nat. Hist. Soc. 77*: 131-137.

MUNDKUR, T. & V. TAYLOR (1993): Asian waterfowl Census 1993. AWB, Kuala Lumpur, Malaysia and IWRB, Slimbridge, U.K.

NAGULU, V. & J.V. RAMANA RAO (1983): Survey of south Indian pelicanries. *J. Bombay nat. Hist. Soc. 80*: 141-143.

NAIK, R.M. (1991): Executive summary of the final report on the "Coastal marine ecosystems and anthropogenic pressure in the Gulf of Kachchh. WWF-India, Gujarat.

NAIK, R.M. & B.M. PARASHARYA (1988): Impact of the food availability, nesting-habitat destruction and cultural variations of human settlements on the nesting distribution of a coastal bird, *Egretta gularis,* in Western India. *J. Bombay nat. Hist. Soc. 84*: 350-360.

NAIK, R.M., M.S. MURTHY, A.P. MANSURI, Y.N. RAO, R. PARVEZ, T. MUNDKUR, S. KRISHNAN, P.J. FALDU & T.S.V.R. KRISHNA (1991): WWF - India sponsored project on Coastal Marine ecosystems and anthropogenic pressures in the Gulf of Kachchh. Final report. Department of Biosciences, Saurashtra University, Rajkot, Gujarat, India.

NAIK, S. (1987): A heronry at Kandivali, Bombay. *Hornbill 1987 (4)*: 25-27.

NAIK. S. (1987): Heronry at Indapur. *Newsletter for Birdwatchers 29(11&12)*: 5.

NAIR, M.V. (1996): Large Cormorant *Phalacrocorax carbo sinensis* (Shaw) breeding in the Nilgiris. *J. Bombay nat. Hist. Soc. 93*: 89.

NAIR, N.R. & K.V. NAIR (1973): A note on the breeding of Darters (*Anhinga melanogaster*) in Periyar Lake. *Indian Forester 99*: 621.

NEELAKANTAN, K.K. (1949): A South Indian pelicanry. *J. Bombay nat. Hist. Soc. 48*: 656-666.

NEELAKANTAN, K.K. & S. ELAMON (1984): Teals or tourism. *Hornbill* 1984 (3): 20-22.

NEGINHAL, S.G. (1977): Discovery of a pelicanry in Karnataka *J. Bombay nat. Hist. Soc. 74*: 169.

NEGINHAL, S.G. (1980): Floods at Ranganathittu Bird Sanctuary. *Newsletter for Birdwatchers 20(1)*: 8-9.

NEGINHAL, S.G. (1983): The birds of Ranganathittu. *J. Bombay nat. Hist. Soc. 79*: 581-593.

NEGINHAL, S.G. (1993): The bird village. *Sanctuary Asia 13(4)*: 26-33.

PAKARD, H.N. (1903): Notes on the breeding of certain herons, etc. in southern India. *J. Bombay nat. Hist. Soc. 15*: 138.

PANDEY, V. (1993): Estuarine crocodile catches a Lesser Adjutant Stork. *Specialist group on storks, ibises and spoonbills Newsletter 6 (1/2)*: 5.

PARASHARYA, B.M. & R.M. NAIK (1990): Ciconiiform birds breeding in Bhavnagar City, Gujarat: A study of their

nesting and plea for conservation. *In*: J.C. Daniel and J.S. Serrao (eds.): Conservation in Developing Countries: Problems and Prospects. pp. 429-445. Oxford Univ. Press, Bombay.

PAULRAJ, S. (1984): Studies on Vedanthangal bird sanctuary. Project report Final Part 1. Madras: Tamil Nadu Forest Department. pp. 132.

PAULRAJ, S. & S. KONDAS (1987): Two centuries of protection of a waterbird sanctuary: how it may benefit the protectors. *Environ. Conserv. 14*: 363-364.

PERENNOU, C. & T. MUNDKUR (1991): Asian Waterfowl Census 1991. IWRB, Slimbridge, U.K.

PERENNOU, C. & T. MUNDKUR (1992): Asian Waterfowl Census 1992. IWRB, Slimbridge, U.K.

PERENNOU, C., T. MUNDKUR & D. SCOTT (1994): The Asian waterfowl Census 1987-91: Distribution and status of Asian Waterfowl. AWB, Malaysia and IWRB publication, U.K.

PERENNOU, C., P. ROSE & C. POOLE (1990): Asian waterfowl 1990. IWRB, Slimbridge, U.K.

PRASAD, S.N. (1992): An ecological Reconnaissance of Mangals in Krishna Estuary: Plea for conservation. *In*: K.P. Singh and J.S. Singh (eds.), Tropical Ecosystems: Ecology and Management. Wiley Eastern Ltd., New Delhi.

RAGUNATHA, V. (1993): An ecological study of Waterbirds at Gudvi Bird Sanctuary. Final Report of the study sponsored by the Conservation Corps Volunteer Programme, WWF - India, New Delhi.

RAGUNATHA, V., S. SUBRAMANYA, L. SHYAMAL, R. LOKESH & R. VASUDEVA (1992): A preliminary survey of Gudvi bird sanctuary. *My Forest 28*: 265-274.

RAJ, M. (1990): Adjutant Stork *Leptoptilos dubius* breeding in Nowgaon. *Newsletter for Birdwatchers 30(5 & 6)*: 8-9.

RAMAKRISHNA, C. (1990): Vedurupattu - Painted Stork *Mycteria leucocephala* nesting place. *Mayura 7 & 8*: 34-36.

RANJITSINH, M.K. (1985): An "island" sanctuary in Kutch. *J. Bombay nat. Hist. Soc. 82*: 180-182.

RHENIUS, C.E. (1907): Pelicans breeding in India. *J. Bombay nat. Hist. Soc. 17*: 806-807.

SAHA, S.S. (1969): A heronry of Purple Herons in the Salt Lake, near Calcutta. *Newsletter for Birdwatchers 9(10)*: 6-7.

SAIKIA, P. & P.C. BHATTACHARJEE (1990a): Nesting records of Greater Adjutant Storks in Assam, India. ICBP/IWRB Specialist Group on Storks, Ibises and Spoonbills Newsletter *3(1/2)*: 2-3.

SAIKIA, P. & P.C. BHATTACHARJEE (1990b): Discovery of Greater Adjutant nesting colonies outside the protected areas of Assam, India. *Newsletter for Birdwatchers 30(7 & 8)*: 3.

SAIKIA, P. & P.C. BHATTACHARJEE (1993): Status, diversity and decline of waterbirds in Brahmaputra valley, Assam, India. Pp. 20-27. *In*: A. Verghese, S. Sridhar and A.K. Chakravarthy, eds. Bird conservation, strategies for the nineties and beyond. Bangalore: Ornithological Society of India.

SAMPATH, K. (1993): Ecological evaluation of irrigation tanks in the Tiruvannamalai Sambuvarayar district of Tamil Nadu, India. Pp. 142-144 in A. Verghese, S. Sridhar and A.K. Chakravarthy, eds. Bird conservation, strategies for the nineties and beyond. Bangalore: Ornithological Society of India.

SANJAY, G.S. (1993): An ecological study of birds at Kokkare Bellur. Final Report of the study sponsored by the Conservation Corps Volunteer Programme, WWF-India, New Delhi.

SANKHALA, K. (1990): Garden of Gods: The waterbird sanctuary at Bharatpur. Vikas Publishing House, New Delhi.

SANTHARAM, V. & R.K.G. MENON (1991): Some observations on the water-bird populations of the Vedanthangal Bird Sanctuary. *Newsletter for Birdwatchers 31 (11 & 12)*: 6-8.

SCOTT, D.A. & P.M. ROSE (1989): Asian Waterfowl 1989. IWRB, Slimbridge, U.K.

SHAHI, S.P. (1983): A little known bird sanctuary. *Hornbill 1983 (2)*: 30-32.

SHARATCHANDRA, H.C. (1980): Studies on the breeding biology of birds and pesticide residues at Ranganathittu Bird Sanctuary in Madhya district, Karnataka. *Mysore J. Agric. Sci. 14*: 264.

SHIVRAJKUMAR, R.M. NAIK & K.S. LAVKUMAR (1961): A visit to the flamingos in the Great Rann of Kutch. *J. Bombay nat. Hist. Soc. 57*: 465-478.

SHIVRAJKUMAR, Y. (1962): A visit to Bharatpur, Rajasthan. *Newsletter for Birdwatchers 2(10)*: 2-5.

SINGH, N. & N.S. SODHI (1986): Heronries and the breeding population density of the Cattle Egret, *Bubulcus ibis coromandus* (Boddaert): during 1985, in Tehsil Kharar of the Ropar district (Punjab). *Pavo 23*: 77-84.

SONI, R.G. (1992): Unusual breeding site of Night Heron *Nycticorax nycticorax* (Linn.). *J. Bombay nat. Hist. Soc. 88*: 443.

SONOBE, K. & S. USUI (1993): (eds.) A Field Guide to the Waterbirds of Asia. Wild Bird Society of Japan, Tokyo.

SRIDHAR, S. (1992): Red Data bird: Spotbilled Pelican. *Newsletter for Birdwatchers 32(1-2)*: 19-20.

SUBRAMANYA, S. (1990): Tanks as waterfowl habitats. *IWRB News.* (Lond.) 2: 5-6.

SUBRAMANYA, S. (1993a): Information Request: Catalogue of Indian heronries. *IWRB News. 9*: 11.

SUBRAMANYA, S. (Unpublished): Catalogue of Indian Heronries.

SUBRAMANYA, S. (1993b): Opportunistic feeding by egrets. *Newsletter for Birdwatchers 33*: 22-23.

SUBRAMANYA, S. & K. MANU (1996): Saving Spotbilled Pelican: A successful experiment. *Hornbill 1996 (2)*: 25.

SUBRAMANYA, S., S. KARTHIKEYAN & J.N. PRASAD (1991): Ranganathittu: Flood Havoc and Aftermath. *Newsletter for Birdwatchers 31 (9 & 10)*: 5-7.

TAHER, S.A. (1985): Nellapattu and Pulicat Bird Sanctuaries in Andhra Pradesh after the November, 1984 cyclone. *Mayura 6 (1-4)*: 21-25.

TIWARI, J.K. (1993): New breeding site for Glossy Ibis *Plegadis falcinellus* in India. *Specialist Group on Storks, Ibises and Spoonbills Newsletter 6(1/2)*: 5-6.

URFI, A.J. (1989a): Painted Storks of the Delhi Zoo. *Sanctuary 9(4)*: 26-33.

URFI, A.J. (1989b): Breeding and habitat selection patterns by Painted Storks *Mycteria leucocephala* in Delhi Zoological Park heronries. Abstract. *Water Study Group Bull. 57*: 26.

URFI, A.J. (1992): The significance of Delhi Zoo for waterbird conservation. *International Zoo News 39*: 13-16.

URFI, A.J. (1993a): Heronries in the Delhi region of India. *Oriental Bird Club Bull. 17*: 19-21.

URFI, A.J. (1993b): Breeding patterns of Painted Storks (*Mycteria leucocephala* Pennant) at Delhi Zoo, India. *Colonial Waterbirds 16*: 95-97.

URFI, A.J. (1992b): Bijana Peepul: a new breeding site for Painted Stork discovered in Delhi region. *Newsletter for Birdwatchers 32 (11 & 12)*: 10-11.

UTHAMAN, P.K. (1990): Breeding of egrets in Kerala. *J. Bombay nat. Hist. Soc. 87*: 139.

VAN DER VEN, J. (1987): Asian Waterfowl 1987: Midwinter Bird Observations in some Asian Countries. IWRB, Slimbridge, England.

VENKATARAMAN, C. & MUTHUKRISHNAN, S. (1993): Density of waterbirds at Vedanthangal Bird Sanctuary, Tamil Nadu. *In*: Bird Conservation: Strategies for the nineties and beyond. A. Verghese, S. Sridhar and A.K. Chakravarthy (eds.), Ornithological Society of India, Bangalore. pp. 55-60.

VENKATESH, B., SHIVANNA & S. SUBRAMANYA, (In press): Breeding Spotbilled Pelicans in Captivity. Paper presented at the Sálim Ali Centenary Seminar on Conservation of Avifauna of Wetlands and Grasslands. February 12-15, 1996. Bombay, India.

VERGHESE, A., A.K. CHAKRAVARTHY & R.K. BHATNAGAR (1982): Bird life in Ghana Bird sanctuary, Bharatpur (India), before and after the 1979 drought. *Cheetal 23*: 13-23.

VIJAYAN, V.S. (1991): Keoladeo National Park ecology study (1980-1990). Final report. Bombay Natural History Society, Bombay.

WEBB-PEPLOE, C.G. (1945): Notes on a few birds from south of the Tinnevelly district. *J. Bombay nat. Hist. Soc. 45*: 425-426.

WILKINSON, M.E. (1961): Pelicanry at Kundakulam, Tirunelveli district. *J. Bombay nat. Hist. Soc. 58*: 514-515.

WWF INDIA (1992): Conservation of Greater Adjutant Stork in Assam. New Delhi: WWF India.

WILSON, J. (1979): Social forestry in Tamil Nadu. *Indian Forester 105*: 305-313.

WILSON, J. (1986): Management of Community forests in Tamil Nadu. *Indian Forester 112*: 305-313.

APPENDIX

DETAILS OF THE HERONRIES REFERRED TO IN THE TEXT

Name of the Heronry	State	District	Nesting species	Source*
Aji-II Reservoir	Gujarat	Rajkot	GC, PrH, WSB	Taej Mundkur
Aji-III	Gujarat	Rajkot	PS	Taej Mundkur
Basaveshvarnagar	Karnataka	Bangalore	LC, NH	Personal observations; Gopi, Prasad
Baroda Zoo Aviary	Gujarat	Baroda	LC, NH, PH, CE, LE	Geetha Padate
Bhaider Island	Gujarat	Jamnagar	OD, WRE, GE, GH	Naik *et al.,* 1991; Taej Mundkur
Chank Island	Gujarat	Jamnagar	WRE, GE, GH	Naik *et al.,* 1991; Taej Mundkur
Chedayankali	Kerala	Palakkad	NH, PH, LE	J. Praveen
Coring Wildlife Sanctuary	Andhra Pradesh	East Godavari	LC, NH, PH, CE, WRE, LE, SE, OBS	Ashok Kumar, V.; Vasudeva Rao and V. Nagulu
Cuddapah	Andhra Pradesh	Cuddapah City	CE, LE,	Riaz Uddin
Dhemaji Village	Assam	Dhemaji	PH, OBS	Baker, 1935
Dibrugarh	Assam	Dibrugarh	GC	Baker, 1935
Gadhula Village	Gujarat	Bhavnagar	WRE	Naik and Parsharya (1987).
Gandhiya Baug Island	Gujarat	Surat	NH, PH, CE, WRE, LE, GH, PS	Sneha Patel & Akshy Joshin

APPENDIX (*Continued*)

Name of the Heronry	State	District	Nesting species	Source*
Gandhiya Kodo Island	Gujarat	Jamnagar	OD, PH, WRE, GE, GH, BHI	Naik *et al.,* 1991; Taej Mundkur
Goalpara Swamp	Assam	Goalpara	PrH	Baker, 1935
Gourikoppa Village	Karnataka	Hassan	LC	K.V. Srinivas
Hebbal Campus	Karnataka	Bangalore	NH	Personal observation
Hemisar Tanl	Gujarat	Kutch	CE	Ali, 1947; Chhaya, 1993
Indapur	Maharashtra	Pune	GH, PS, BHI, BI	Prakash Gole; Anirudh Chaoji; S.N. Naik
Jagrugumilli Village	Andhra Pradesh	Prakasam	PS	K. Mruthunjay Rao
Jodhpur Zoo	Rajasthan	Jodhpur	LE	Indra Kumar Sharma
Kadakkal	Kerala	Trivandrum	PH, LE	K. Rafeek
Kalaghoga Reservoir	Gujarat	Kachchh	PS, BI, WSB	Shanthilal Varu
Kalubhar island	Gujarat	Jamnagar	NH, WRE, BHI	Naik *et a.,* 1991; Taej Mundkur
Kamaleshwar dam	Gujarat	Junagadh	egrets, herons, PS	Anwarkhan Babi
Kanjikode	Kerala	Palakkad	LC, NH, PH, LE	J. Praveen
Khara Chusna Island	Gujarat	Jamnagar	OD, PH, WRE, GE, GH	Naik *et al.,* 1991; Taej Mundkur
Karanji Tank	Karnataka	Mysore	OD, GC, PS, WSB	K. Manu
Khijadia Bird Sanctuary	Gujarat	Jamnagar	PH, RE, PS, BHI	Taej Mundkur
KTC Bus Stop	Kerala	Palakkad	LC, NH, PH, LE	J. Praveen
Kukkralli Tank	Karnataka	Mysore	SBP, OD, PS, WSB	K. Manu, Personal observation
Lankivanidibba	Andhra Pradesh	Krishna	GC, IS, NH, PH, CE, WRE, GE, GH, PS, OBS, WSB	Narendra Prasad; Prasad, 1992
Lakhimpur Swamp	Assam	Lakhimpur	LC, PrH	Baker, 1935
Luna Village	Gujarat	Kuchchh	LC, NH, CE, LE, WSB, GI	Thiwari, 1993; Thiwari
Malleswaram	Kanataka	Bangalore	NH	Personal observation
Manali	Kerala	Palakkad	NH, PH, LE	J. Praveen
Mithikhari Reservoir	Gujarat	Surendranagar	WSB	Taej Mundkur
Morvi Town	Gujarat	Morvi	NH, CE, LE	Taej Mundkur
Nayri Reservoir	Gujarat	Rajkot	WSB	Taej Mundkur
Nora Island	Gujarat	Jamnagar	OD, WRE, GE, GH	Naik *et a.,* 1991; Taej Mundkur
Nooranad	Kerala	Allappuzha	LC, OD, NH, PH, LE, SE, GE	K. Rafeek; P.K. Uttamar
Patchava Village	Andhra Pradesh	Prakasam	PS	K. Mruthunjay Rao
Pandoli Tank	Gujarat	Kheda	LE, SE, OBS. WNS, BI	R.B. Balar, L.M. Raol, P.S. Thakker
Peppara	Kerala	Trivandrum	LC	Deepakumar Kurup
Pirotan Island	Gujarat	Jamnagar	LC, OD, NH, PH,WRE, GE	Naik *et al.,* 1991; Taej Mundkur
Pithalpur Village	Gujarat	Bhavnagar	CE, RE	Naik and Parasharya, 1987
Pudugramam Osaravila	Tamil Nadu	Kanyakumari	CE	C. Susanthakumar
Ratanpur Jheel	Gujarat	Ahmedabad	LC, CE, LE, BI	S. Satkopan
Railway colony Jodhpur	Rajasthan	Jodhpur	CE, LE	Indra Kumar Sharma
Rozi Island	Gujarat	Jamnagar	NH, PS	Naik *et al.,* 1991; Taej Mundkur
Sardhar Reservoir	Gujarat	Rajkot	WSB	Taej Mundkur
Simpson Estate	Tamil Nadu	Madras	LC, IS, OD, LE, CE, RE, ME, GE, GH, BHI, WSB	V. Gurusami
Soolekere	Karnataka	Mandya	SBP, PS	K. Manu; Personal observation
Telikunchi Village	Andhra Pradesh	Srikkakulam	OBS +	U.N. Dev; Divya Muddappa, B.C. Choudhury

APPENDIX (*Continued*)

Name of the Heronry	State	District	Nesting species	Source*
Tsundur Village	Andhra Pradesh	Guntur	LC, CE, LE, OBS	K. Mruthunjay Rao
Udayamarthandapuram	Tamil Nadu		GC, IS, LC, OD, NH, PH, CE, LE, GH, PS, OBS, BI, WSB	K. Sivasubramaniam
Ulloor	Kerala	Trivandrum	LC, PH	C. Susanthakumar
Vattapara	Kerala	Trivandrum	NH, LE	Manoj V. Nair, C. Susanthakumar
Visveswaraiah Canal Farm	Karnataka	Mandya	PH, CE, LE	Pers. observation

* Names refer to information obtained through personal communications.